*A star (✱) indicates that the Abstract deals with Apparatus and Instruments.*

**JUNE, 1937.**

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# GENERAL PHYSICS.

## ADSORPTION.

**2279. Validity of Traube's Rule at Liquid-Liquid Interfaces. Sonja Boas-Traube and M. Volmer.** *Zeits. f. phys. Chem.* 178. *Abt. A.* 4. *pp.* 323–335, 1937.—Measurements were made at 20°±0·5°, by the drop-number method, of the interfacial tension between benzene and water mutually saturated and containing in solution the first six members of the normal fatty acid series. The results are in agreement with Traube's rule and with the equivalent equation of von Szyszkowski, viz.: $(\sigma_0-\sigma_t)/\sigma_0=\mathrm{B}\log(c/\mathrm{A}+1)$. A discussion of the results in the light of Langmuir's adsorption isotherm shows that at the water-benzene interface as in water the fatty acid solute is monomolecular but in benzene it is bimolecular, except in the case of formic and to a less extent of acetic acid. This conclusion was confirmed by determination of the partition coefficients. L. V. C.

**2280. Kinetics of Activated Sorption of Hydrogen on Chromic Oxide Gel. L. Clarke, L. S. Kassel and H. H. Storch.** *Am. Chem. Soc., J.* 59. *pp.* 736–740, *April*, 1937.—An analysis of Burwell and Taylor's data [see Abstract 2921 (1936)] on the activated sorption of $H_2$ by chromium oxide has led to the derivation of a rate equation that fits the data for moderate amounts of sorption very well. The derivation is based on a simple model of the sorption process, involving primary adsorption followed by diffusion to secondary centres. This model also accounts, qualitatively at least, for the failure of the equation at extreme conditions. AUTHORS.

**2281. Adsorption Isotherms of Hydrogen on Charcoal between 90° K. and 50° K. A. van Itterbeek and W. van Dingenen.** *Physica*, 4. *pp.* 389–402, *May*, 1937. *In English.*—With the intention to establish a thermodynamical heat balance of Simon-desorption experiments, the adsorption isotherms of $H_2$ on charcoal in the temperature range between 90° K and 50° K are determined on two kinds of charcoal with a great degree of adsorption. From the isotherms are calculated the heats of adsorption by using the Clapeyron-Clausius formula. The isothermal curves for the heat of adsorption have been determined as a function of pressure. Hyperbolic curves are found. New desorption experiments are made with the two kinds of charcoal at definite equilibrium pressures, and starting from different temperatures. From the cooling obtained, in connection with the theoretical heat of desorption, interesting conclusions can be drawn concerning the desorption process. Considering the heat of desorption developed in these experiments, it can be concluded, by using an extrapolation of the adsorption-isotherms and of the curves for the heat of adsorption as a function of pressure, that it must be possible to attain the critical point of $H_2$, working with a minimum pressure of about 2·5 atmos. and starting from 67° K. AUTHORS.

**2282. Adsorption on Measured Surfaces of Vitreous Silica.—Part II. W. G. Palmer.** *Roy. Soc., Proc.* 160A. *pp.* 254–267, *May* 18, 1937.—Earlier work [see Abstract 1887 (1935)] on the adsorption of vapours on known surfaces of vitreous silica has been extended, and isothermals at 25° have been obtained from low pressures up to saturation for benzene, acetone, and methyl alcohol. The S-shaped form of the isothermals is discussed, and reasons advanced for attributing the whole of the condensation to pure adsorption. The films are 4 molecules thick at saturation, but the linear relation between the logarithm of the adsorption potential and the amount adsorbed holds strictly over almost the whole pressure range. The spreading force is calculated from the experimental observations, and the values shown to agree with those calculable from certain equations of state for the films. Strong repulsive forces are accounted for quantitatively by dipole repulsion, and the observed maximum value of the adsorption potential can be successfully worked out on the basis of dipole interaction between the surface and the adsorbed molecules. The behaviour of the films of small molecules on the solid is compared with that of films of long-chain molecules on water. AUTHOR.

**2283. Rate of Sorption of Water Vapour on Silica Gel and Iron-Silica Gel. W. A. Patrick and L. H. Cohan.** *J. Phys. Chem.* 41. *pp.* 437–443, *March,* 1937.—At 25° C. and at a vapour pressure of water of 4·6 mm., 2–3 hr. is sufficient to establish equilibrium between silica gel and water, provided the pressure of the permanent gas present is below 0·5 mm. That is, the rate of adsorption of water on silica gel is independent of the permanent gas present when the pressure of that gas is below 0·5 mm. At higher pressures of gas the rate is an inverse function of the pressure and the molecular weight of the gas present. Thus at a given pressure the rate is most rapid in $H_2$. The rate of desorption of the last part of the water to be pumped off is an inverse function of the pressure and molecular weight of the gas present during the previous adsorption. The desorption of the first and larger portion of water is quite independent of the gas present. The rate of desorption from an iron-silica gel, following adsorption *in vacuo*, is much less than in the case of silica gel, and is similar to the rate of desorption for silica gel following adsorption in the presence of a gas. All the observed facts may be qualitatively accounted for on the basis of the resistance of an inert gas to diffusion of water vapour, both in the vapour phase around the gel and in the pores of the gel. AUTHORS.

**2284. Formation and Structure of Active Beryllium and α-Iron-III Oxides. R. Mumbrauer and R. Fricke.** *Zeits. f. phys. Chem.* 36. *Abt.B.* 1. *pp.* 1–19, 1937.—Hahn's emanation method is applied to the procedure of dehydration of α-Be$(OH)_2$ and α-FeOOH at different temperatures, and also to the influence of tempering upon the active oxide formed by dehydration of the crystalline hydroxide. The amount of emanation is enhanced by dehydration, whereas tempering produces a decline. Parallel experiments were carried out by X-rays on a greater portion of the preparations for particle size, when it was found that this method indicated a much greater total surface than that calculated by the emanation method. The conclusion is drawn from the Hahn emanation experiments that the secondary structure is of great influence upon the results, while the use of the short-lived Th emanation is recommended for the experiments. [See following Abstract.] H. H. Ho.

**2285. Adsorption of Water and Carbon Dioxide by Active Oxides. R. Mumbrauer.** *Zeits. f. phys. Chem.* 36. *Abt.B.* 1. *pp.* 20–26, 1937.—It is found that the $H_2O$ and $CO_2$ additions proved to be

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reversible adsorptions, and that whereas the $H_2O$-adsorption caused a rapid ascent, the $CO_2$-adsorption on the contrary produced a rapid decline of the emanative power; also both these procedures are completely reversible. Both phenomena have been explained as due to changes effected by the adsorption on the secondary structure and thence upon its emanative power. The water dispositions effect a loosening of the secondary structure, the much smaller $CO_2$-acceptance (which only occurs in the most active BeO-varieties) on the other hand effects a kind of baking of the particles (formation of basic beryllium carbonate at the particle surfaces). In the simultaneous action of $CO_2$ and $H_2O$ upon strongly active BeO the former outweighs the influence of the latter. [See following Abstract.] H. H. Ho.

**2286. Dependence of the Hahn Emanation Method upon Packing Density. R. Fricke and O. Glemser.** *Zeits. f. phys. Chem.* 36. *Abt. B.* 1. *pp.* 27–29, 1937.—In agreement with Mumbrauer's results [see preceding Abstract] it has been established, by the use of radiothorium as infecting element and with very finely divided substances, that Hahn's emanation method depends strongly on the packing density, elevation of which reduces the amount of emanation. H. H. Ho.

**2287. Wood-Water Relationships. Part III. W. W. Barkas.** *Phys. Soc., Proc.* 49. *pp.* 237–242, *May* 1, 1937.—The apparent molecular sorption of water by Sitka spruce flour is shown to remain constant at about 23% of the dry weight of the wood over a period of 83 days when a sucrose solution is used as the indicator, but with NaCl solutions a gradual fall in the apparent sorption occurs which reaches a value of about 5% after 14 days. This fall is here put down to the slow sorption of the salt and not to a low value of the true molecular sorption. It is also suggested that the low value of the molecular sorption derived by Stamm and Loughborough from considerations of the heat of wetting of wood is due to their assumption that molecular sorption is complete at about 30 % relative vapour pressure, when the capillary sorption commences. [For Part II see Abstract 2923 (1936).] AUTHOR.

**2288. Electric Charge at an Oil-Water Interface. W. C. M. Lewis.** *Faraday Soc., Trans.* 33. *pp.* 708–713, *May*, 1937.—On the assumption that the energy of adhesion at an interface is a measure of the upper limit which can be ascribed to the energy of the condenser due to the Helmholtz double layer of electricity associated with the interface, values may be obtained for the (maximum) charge density at the interface water-organic liquid in a number of cases. It is shown that the value so obtained leads to a reasonable value for the electrostatic capacity of the double layer and further, in the only case in which direct experimental test is available, namely the interface mercury-aqueous solution of electrolyte, the charge density calculated on the above basis agrees as to order of magnitude with that obtained from electrocapillary data. AUTHOR.

*See also* Abstract 2441.

## ATOMIC AND MOLECULAR STRUCTURE.

**2289. Perturbation Theory of Light Nuclei: $He^4$ and $Li^6$. D. R. Inglis.** *Phys. Rev.* 51. *pp.* 531–544, *April* 1, 1937.—The binding energies of the four- and six-body problems are approximately calculated using different types of interaction force between the elementary particles. The approximation consists in starting with independent particles in a suitable

potential field (harmonic oscillator) and treating then their correlations as a small perturbation. The convergence and validity of this approximation is discussed. Of the many possible interaction terms only one gives results which are in satisfactory agreement with the experiment.
R. P.

**2290. Structure of Light Nuclei. E. Feenberg and M. Phillips.** *Phy. Rev.* 51. *pp.* 597–608, *April* 15, 1937.—Extensive calculations based on the approximation of single particle wave functions (the Hartree method) have been made for the nuclei between $He^6$ and $O^{16}$. The Coulomb interaction is treated as a small perturbation. Secular equations are avoided by the construction of space wave functions in the normal state configuration belonging to irreducible representations of the symmetric group. These functions yield an energy matrix which is diagonal in the ordinary and Majorana interaction energies. The contributions of the spin exchange and Coulomb operators to the energy terms are found by a first-order perturbation calculation. Although the general symmetrical operator employed contains several parameters as yet undetermined, only those parameters which have been fixed by consideration of the two, three and four particle problems are involved in the energy differences within the group of low lying terms belonging to the normal state configuration. These term differences are identical with those recently computed for unsymmetrical interaction operators of the saturation type. New results for mass defects, excitation energies and energy relations between isobares are compared with experimental values.
AUTHORS.

**2291. Nuclear Forces. P. Jordan.** *Naturwiss.* 25. *pp.* 273–279, *April* 30, 1937.—A critical survey is given of the state of existing knowledge on the subject of nuclear forces. The points dealt with in particular include, the binding energies of nuclei, the potential hill in the field of the nucleus, the deuteron, the scattering of neutrons by protons, the effect of protons on protons, the forces in existence at $\beta$-disintegration and the elementary length *g*, the Fermi constant. G. O. B.

**2292. Interaction of Nuclear Particles. B. Kahn.** *Physica,* 4. *pp.* 403–405, *May,* 1937. *In English.*—The Fermi theory of $\beta$-emission is applied to the interaction between two heavy particles (neutrons and/or protons) taking into account terms of fourth approximation. These terms give divergent results. If they are made convergent by introducing a damping factor into the integrations the result tends to infinity if the damping is made infinitely weak. It is concluded that the present theory is insufficient to calculate the interaction between nuclear particles. R. P.

**2293. Symmetry Properties of the Forces in Atomic Nuclei. F. Hund.** *Zeits. f. Physik,* 105. 3–4. *pp.* 202–228, 1937.—The assumption of equal forces between equal and unequal nuclear particles leads to simple results. In addition to spin multiplicity of the terms, a charge multiplicity is obtained which expresses a relationship between terms of isobaric nuclei. With some limitations calculations of the energies of states can be made. In particular, potential energies of nuclei with 5 to 16 particles (building up the *p*-shell) are obtained as simple linear functions of two integrals.
C. B. A.

**2294. Density of Energy Levels of Heavy Nuclei. J. Bardeen.** *Phys. Rev.* 51. *pp.* 799–803, *May* 15, 1937.—The present calculation of the density of energy levels of a heavy nucleus is based on the statistical model of van Vleck. As in Bethe's calculation, the particles are assumed to move in a simple potential hole, but the depth of the hole varies with the velocity of the particle. If exchange forces act, the interaction energy of a given particle with the remainder of the nucleus decreases as the velocity of the particle increases. This results in a lower density of states of the individual particles at the top of the Fermi distribution. Bethe's formula for the density of excited levels of the nucleus as a whole may be applied to the present situation if this change in the density of the individual particle states is taken into account. The spacing between the levels is over a hundred times larger than that found by Bethe, and, if one uses the Gamow value for the radius of a radio-active nucleus ($\sim 9 \times 10^{-13}$ cm.), is much too large to be reconciled with the frequent occurrence of resonance levels for the capture of slow neutrons. If one uses the new value for the radius suggested by Bethe ($\sim 13 \times 10^{-13}$ cm.), the present theory gives more reasonable values. [See Abstract 4435 (1936).] AUTHOR.

**2295. Disintegration of Cadmium with Deuterons. J. M. Cork and R. L. Thornton.** *Phys. Rev.* 51. *pp.* 608–611, *April* 15, 1937.—The bombardment of a Cd target by deuterons of energy 6·3 eMV yields certain radio-active isotopes. Chemical analysis of the bombarded metal shows the presence of two radioactive isotopes of Cd having half-life periods of 4·3 hr. and 58 hr. respectively. Both emit negative electrons. The long-period Cd activity gives rise to a radioactive In of half-life 2·3 hr. This In isotope in succession emits negatives resulting in the formation of a stable Sn isotope. Successive chemical separations carried out over a period of 60 hr. showed the In to be in equilibrium with the long period Cd. The existence of radioactive isotopes of half-life periods shorter than about 30 min. is not precluded. AUTHORS.

**2296. Transmutation in the Chemical Laboratory. F. A. Paneth.** *Chem. Soc., J. pp.* 642–654, *April*, 1937.—This sixth Liversidge lecture opens with some discussion of alchemy in relation to modern developments, and passes on to Ra and the radiochemical and chemical study of spontaneous transformations, the former illustrated by the disintegration of Th and the discovery of isotopes, and the latter by the detection of He from Ra and of Ra-*D* from radon. The subject of artificial transmutation is historically reviewed, and its radiochemical and chemical study for the period 1919–1934, including the discovery of the artificial radioelements in 1923 and the effects of bombardment by $\alpha$-rays, neutrons, and accelerated particles of H and D is discussed in some detail. The lecture concludes with an extended survey of the lines and directions in which future research seems most promising. N. M. B.

**2297. Disintegration of Boron by Slow Neutrons. E. Fünfer.** *Ann. d. Physik,* 29. 1. *pp.* 1–10, *May,* 1937.—The degree of accuracy for measurements made with a proportional counter in conjunction with a proportional amplifier is demonstrated with Sm, the $\alpha$-particles from which are shown to have a range of 11·4 mm. The disintegration of B by slow neutrons and the corresponding energy interchanges are found to be in agreement with calculations based on considerations of mass defect. Ionisation measurements on the short range disintegrations show approximate agreement with other results obtained hitherto for such particles. F. C. C.

**2298. Radioactivation of Silver by Neutrons. G. Guében.** *Ann. Soc. Sci. de Bruxelles,* 57. *pp.* 22–24, *March* 16, 1937.—Ag was irradiated with neutrons from Ra + Be for various periods with and without interposition of paraffin. The radioactive material produced showed three periods: (I) 46 ± 4 sec., only obtained when no paraffin was interposed,

(II) 31 ± 3 sec., only formed when paraffin was interposed, and (III) 2·5 min. formed in either case, but more when paraffin was present, and also formed in greater quantity the longer irradiation continued. It is suggested that one of them may be radiorhodium : ${}^{x}_{47}\text{Ag} + {}^{1}_{0}n = {}^{x-3}_{45}\text{Rh} + {}^{4}_{2}\text{He}$.
C. A. S.

**2299. Transmutation Functions at High Bombarding Energies. H. W. Newson.** *Phys. Rev.* 51. *pp.* 620–623, *April* 15, 1937.—The differential transmutation functions of the reactions, $C^{12} + D^{2} = N^{13} + n^{1}$, $N^{14} + D^{2} = O^{15} + n^{1}$, $O^{16} + D^{2} = F^{17} + n^{1}$, have been measured at bombarding energies from 2 to 5 eMV. All three curves showed a well marked change of slope at the top of the potential barriers. These points corresponded to potential barrier heights of 2·8, 3·2, and 3·1 eMV for C, N and O, respectively. These values are slightly more than half those reported for the same elements with α-particles. The absolute cross-sections for disintegration at the top of the potential barrier are 4·0, 2·8 and 6·0 × $10^{-26}$ cm². for the elements in order. At bombarding energies greater than the tops of the potential barriers the curves show interesting effects which are probably due to interfering side reactions. AUTHOR.

**2300. Radioactivity Induced in Silicon and Phosphorus by Deuteron Bombardment. H. W. Newson.** *Phys. Rev.* 51. *pp.* 624–627, *April* 15, 1937.—Si and P have been bombarded by deuterons and the resulting radioactive substances have been studied. The two reactions, $Si^{30} + D^{2} = Si^{31} + H^{1}$, $P^{31} + D^{2} = P^{32} + H^{1}$, were found to occur. The active substances were identified by the usual chemical tests. The half-life of $Si^{31}$ was found to be 170 ± 10 min. and that of $P^{32}$, 14·5 ± 0·3 days. Both substances were found to emit no γ-rays and advantage was taken of this fact to study the absorption curves of the β-rays with some care. The absorption curves showed very definite end points from which the maximum energy of the β-ray spectra was calculated from Feather's empirical formula. The calculated energies were 1·50 ± 0·01 eMV and 1·59 ± 0·03 eMV for $Si^{31}$ and $P^{32}$ respectively. These values are in satisfactory agreement with the latest direct measurements. The errors in absorption measurements in the presence of γ-rays are estimated from the shape of the absorption curves. AUTHOR.

**2301. Induced Radioactivity. M. E. Nahmias and R. J. Walen.** *J. de Physique et le Radium*, 8. *pp.* 153–159, *April*, 1937.—In an investigation of induced radioactivity, two methods of studying short periods of decay are described ; one employing a horizontal arm moving in pendulum fashion and the other using a horizontally rotating wheel. The radioactivity is induced by bombarding the atoms with neutrons from a radon-beryllium source. New radioactive isotopes are discovered in Li, B, Na and Sn. Their periods are given, as well as the periods of several other radioactive elements. Investigations have also been carried out without success to detect if the negative proton is produced by neutron bombardment. It is also pointed out that the distribution of electronic periods as a function of the logarithm of their frequencies follows a Gaussian law. G. O. B.

**2302. Induced Radioactivity of Light Nuclei. A. Meye.** *Zeits. f. Physik*, 105. 3–4. *pp.* 232–250, 1937.—Artificial radioactivity induced by the α-particles from RaC′ is studied in the elements Al, Mg and N, using a conically shaped ionisation chamber. For the three elements, excitation curves are obtained and also the half-value times of the various radioactive components. In addition absorption curves for the radiation from the isotopes are determined. The radioactive component in Al is found to be

$P^{30}$. It disintegrates with emission of positrons, with a half-value time of 2·9 min. The limiting energy of the emitted radiation is obtained as $2 \cdot 6 \times 10^6$ eV. No resonance levels are found within the limits of measurement. Two active bodies are found in Mg, *i.e.* $Si^{27}$ and $Al^{28}$; half-value times and limiting energies are again given; while excitation levels were found, which indicate that $Mg^{24}$ and $Mg^{25}$ show resonance for the same $\alpha$-particle energy. Similar results were obtained from N, except that no resonance levels are present. The ratios of the total numbers of particles emitted by the activated nuclei were determined. G. O. B.

**2303. $\gamma$-Rays from Light Elements Due to Proton Bombardment. R. G. Herb, D. W. Kerst and J. L. McKibben.** *Phys. Rev.* 51. *pp.* 691–698, *May* 1, 1937.—With the h.v. electrostatic generator recently constructed at this laboratory a survey of a number of elements has been made in a search for $\gamma$-ray emission due to proton bombardment. Six of the elements examined gave $\gamma$-rays of sufficient intensity to permit accurate measurement. These six elements are Li, Be, B, F, Na and Al. Their $\gamma$-ray yield was studied as a function of proton energy, or generator voltage, starting with the minimum potential at which the yield was easily measurable. In the region of fairly low potentials the six elements studied gave evidence for resonance excitation of $\gamma$-radiation and at high potentials each of the six elements gave a $\gamma$-ray intensity which increased nearly exponentially with voltage up to the maximum voltage obtainable from the generator (approximately 2 eMV). The measurements were made using a Lauritsen electroscope, and therefore they give the intensity in arbitrary units which depend on the hardness of the radiation and the geometry of the apparatus. The other elements which were bombarded are C, O, Si, K, Ca, Ni, Cu, Zn, Mo, Pt, Pb. $\gamma$-radiation from these elements was weak and the observed intensities may have been largely due to contaminants. AUTHORS.

***2304. Relative Abundance of Isotopes. W. Bleakney.** *Am. Phil. Soc., Proc.* 77. 3. *pp.* 395–409, 1937.—In this paper a discussion is given of the methods of identifying isotopes with the mass-spectrograph and the difficulties of securing reliable abundance measurements are pointed out. A new mass-spectrograph is described which makes use of many permanent magnets as a means of providing a constant magnetic field. The ion-source used in most of the work is a new type consisting of an atomic jet ionised by slow electrons. New isotopes of Br, In and Rh were sought and evidence was found for $Rh^{101}$ which presumably accounts for the two periods of decay when Rh becomes radioactive. Li, Be and Na were investigated but no new isotopes were found. Indications of a $Co^{57}$ isotope appeared and this observation was checked by the discovery of a new long period activity induced in Co by the absorption of slow neutrons. New isotopes of Sr and Ba were found and other isotopes of Ba recently reported were confirmed. The relative abundance of these isotopes was also measured. Finally the relative abundances of the isotopes of Pd, Ir and Pt were determined and a comparison made with atomic weights. Only Ir showed a sharp disagreement (192·2) with the accepted value (193·1) of the atomic weight. AUTHOR.

**2305. Neutrons of High Energy from Po + Be and the Nuclear Levels of $C^{12}$. G. Bernardini.** *Ricerca Scientifica,* 8. *pp.* 33–41, *Jan.*, 1937.—Besides the three groups of neutrons of energies 4·2, 6·3, and 7·8 eMV, a third weak group of 11 eMV energy is reported. The construction of a nuclear level scheme for $C^{12}$ is discussed in the light of such a high energy neutron group. F. C. C.

**2306. Resonance Capture of Slow Neutrons by Tungsten Nuclei. R. Jaeckel.** *Zeits. f. Physik,* 104. 11–12. *pp.* 762–778, 1937.—A number of elements exhibit the phenomenon of the selective absorption of slow neutrons. The result is that the energy of these neutrons answers directly to a level of the nucleus ${}^{m+1}_{z}A$ (resonance capture), which is formed by the following process: ${}^{m}_{z}A + {}^{1}_{0}n = {}^{m+1}_{z}A$. It has been found that: (1) W which has been irradiated behind Cd absorbers 0·66 mm. thick showed only about half of that activity which it exhibited with irradiation without Cd absorber. (2) The insertion of an additional W-absorber of only 0·1 mm. power for the radiation degraded the rest activity to less than the half (strong absorption). On the contrary a 0·1 mm. strong Ag absorber produces no apparent weakening. That shows that also for W a case of resonance capture of slow neutrons exists. The activation of W to artificial radioactivity by non-thermic neutrons is conditioned by the action of a resonance level. The selective absorbable neutrons in W have an energy of 9 ± 4 volts. J. J. S.

**2307. Resonance Effects in Nuclear Processes. H. A. Bethe and G. Placzek.** *Phys. Rev.* 51. *pp.* 450–484, *March* 15, 1937.—A general formula is developed for the probability of nuclear processes with particular consideration of resonance. The dependence on energy over regions small compared to nuclear energies is completely given by this formula; the variation over larger energies depends on more specific features of the model one assumes. Selection rules are deduced. They differ according to whether light quanta or material particles are concerned and whether the particles are fast or slow. The wave functions which form the basis of the approximations used should be chosen to represent the motion of a particle in a repulsive potential field, since it can be shown that in this way the best approximation is obtained. This is important for the scattering when there is no resonance. The capture of slow neutrons is discussed in detail and the results compared with experiments. Further, the effects produced by fast neutrons and by charged particles, and the photoelectric dissociation of nuclei are discussed. The latter is *not* the inverse process to the capture with emission of radiation. R. P.

**2308. Proton-Neutron Transformation under the Influence of $\gamma$-Radiation. G. Rumer.** *Phys. Zeits. d. Sowjetunion,* 11. 1. *pp.* 48–54, 1937. *In German.*—Based on the Fermi theory of $\beta$-disintegration, the probability has been calculated for a proton or neutron, by absorption of a light-quantum, to be transformed into a neutron or proton respectively by simultaneous emission of a positron or electron. The paper is entirely mathematical, since on account of the smallness of the Fermi constant the effect is also small and outside the possibility of direct observation.
H. H. Ho.

**2309. Scattering of Fast Neutrons by Protons. N. N. Dmitrieff.** *Phys. Zeits. d. Sowjetunion,* 11. 2. *pp.* 225–238, 1937. *In German.*—Assuming a potential energy curve of the type proposed by Mamasachlisow [see Abstract 2479 (1936)], an expression is deduced for the effective cross-section in the scattering of fast neutrons by protons. The author shows that, contrary to the opinion of Mamasachlisow, the expression is not in agreement with Wigner's formula. Moreover the anisotropy of the scattering comes out to be considerable, a result which is at variance with numerous experimental observations. The author therefore concludes

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that Mamasachlisow's theory of the interaction of neutrons and protons must be abandoned. L. A. W.

**2310. Energy Liberated at the Addition of Neutrons. S. Kikuchi, K. Husimi and H. Aoki.** *Zeits. f. Physik*, 105. 3–4. *pp.* 265–266, 1937.—In a note on some work by Fleischmann on the liberation of $\gamma$-rays at the capture by a nucleus of a neutron [see Abstract 5341 (1936)] the authors reply to a statement by Fleischmann on some work of theirs on the same subject. Fleischmann's conclusions are shown to be unjustified. G. O. B.

**2311. Structure of Aromatic Compounds. Part I. Acenaphthene. K. Banerjee and K. L. Sinha.** *Indian Journ. Phys.* 11. *pp.* 21–35, *Feb.*, 1937.—From an analysis of the estimated intensities of X-ray reflections from a number of planes and by combining the available magnetic data, it is found that the 2-fold axis of the molecule lies parallel to the *b*-axis while the molecular plane is inclined at 26° to the *c*-face. The estimated intensities are satisfied by the assumption of a plane structure of the molecule. The distance between an aliphatic C atom and its adjacent aromatic C atoms is 1·47 Å, and that between the two aliphatic C atoms is 2·01 Å. The angle between the aliphatic bond and the aliphatic-aromatic bond is 97° and angles between the latter bond and the adjacent bonds in the naphthalene nucleus are 114° and 126°. AUTHOR.

**2312. Molecular Structure of Silicobromoform. J. Wouters, M. de Hemptinne and P. Capron.** *Ann. Soc. Sci. de Bruxelles*, 57. *pp.* 25–29, *March* 16, 1937.—The structure of silicobromoform is studied by the method of electron diffraction, twelve photographs being taken using two different wave-lengths, 0·05412 and 0·06419 Å. The diffraction rings have been carefully measured and the intensities estimated. The method of radial distribution (Pauling-Brockway) permits of the calculation of the principal interatomic distance, $Br-Br=3{\cdot}63$ Å., with exactness. The distance $Si-Br = 2{\cdot}19 \pm 0{\cdot}05$ Å is known with less certainty. The Si atom cannot be in the plane of the Br atoms; the group $SiBr_3$ forms a regular tetrahedral group in the $HSiBr_3$ molecule, the angle $BrSiBr = 110° \pm 2{\cdot}5°$. C. J. B. C.

**2313. Demonstration Model of Vibrating Molecule. W. H. J. Childs and H. A. Jahn.** *Journ. Sci. Instruments*, 14. *pp.* 141–142, *April*, 1937.—The normal vibrations of a molecule model, made of small weights and connecting springs, are studied by means of an intermittent air current which is regulated by a pendulum of adjustable length. This method has the advantage that, after vibrations have been set up in the "molecule," the air current can be shut off and it is then possible to study the free vibrations without any distortion. R. P.

**2314. Hybrid Molecules. N. V. Sidgwick.** *Chem. Soc., J.* *pp.* 694–699, *April*, 1937.—This paper deals with the modifications which structural chemistry has undergone in the last few years through the introduction of the concept of resonance. The latter is explained as follows: If a molecule can be represented by two (or more) structural formulæ which ascribe approximately the same positions to the atoms and are of about the same stability or energy content, then it is found that the actual state of the molecule is not that represented by either of the formulæ, but as something between them, which cannot be expressed by means of the ordinary structural symbols; it has to some extent the properties of both, but is more stable than either, and also the linked atoms are rather nearer together than is usual. If the structures differ in stability, the actual state will lie nearer to the more stable. The molecule is then said to be a resonance hybrid of the two (or more) forms, and is often much more stable than either of the component structures. This result could not have been anticipated from general considerations, or calculated by classical mechanics, and is due to the applications of wave-mechanics. The general conclusions of the theory of resonance are of great practical importance to the organic chemist, but the theory must be distinguished from that of tautomerism, a term used to denote a mixture of two kinds of molecules in equilibrium after the manner of a reversible chemical reaction. The so-called coordination of H is next dealt with as this accounts for the association of OH compounds, and is shown to be due to resonance between the ordinary form and one in which there is an oxonium kation and an R–O anion. The properties which are most frequently used for the detection of resonance are heats of formation, internuclear distances, dipole moments, force constants of the links, and the general reactivity, and these are discussed and illustrated by examples from tetrachloroethylene, the CO group, and the aromatic ring. H. H. Ho.

**2315. Pattern of Proteins. D. M. Wrinch.** *Roy. Soc., Proc.* 160A. *pp.* 59–86, *May* 1, 1937.—A theory of the structure of the molecule of simple native protein, sufficiently precise to lend itself to experimental test by the methods of organic, physical, enzyme and immunochemistry, is offered as a working hypothesis. Designed to cover certain well established facts in protein chemistry, it suggests that the molecule may contain closed polypeptides and that the polypeptides are cyclised; *i.e.*, they fall into a certain hexagonal ring structure. This hexagonal ring structure, the "cyclol" pattern, obtained by the cyclisation of polypeptides, may be regarded more fundamentally as a suface polycondensation of amino and imino acid molecules. In it the polypeptide, the essential unit in the protein molecule on the classical theory, is replaced by the cyclised polypeptide; and correspondingly the peptide link, which on the classical theory joins one pair of C, N atoms, is replaced by multiple peptide links, in which two or three pairs of C, N atoms are involved. A series of cyclol laminar molecules is discussed with special reference to the unimolecular protein film. Attention is also directed to three-dimensional laminate (multilaminar) molecules and molecular aggregates, consisting of a number of single laminæ superposed and held in position by side chains in covalent linkage and by hydroxyl links. AUTHOR.

**2316. Atomic Weight of Lead from Galena, Great Bear Lake, N.W.T., Canada. J. P. Marble.** *Am. Chem. Soc., J.* 59. *pp.* 653–655, *April,* 1937.—The atomic weight of lead from galena at Great Bear Lake is 207·21. The "common" lead contaminating the "uranium" lead of the pitchblende may have come from this source. Presumably the pitchblende has not lost appreciable quantities of lead by leaching. Further evidence is presented as to the constancy of the atomic weight of "common" lead as a function of its geologic age. AUTHOR.

**2317. Lead-Uranium Ratio of Beaverlodge Pitchblende. G. P. Baxter and M. E. Averill.** *Am. Chem. Soc., J.* 59. *p.* 705, *April,* 1937.—Baxter, Faull and Tuemmler [see following Abstract] have found the atomic weight of the lead contained in a sample of Beaverlodge pitchblende to be 206·08, indicating, in the almost complete absence of Th, that about 7% of this lead is common lead. With the per cent. of U 51·16, and that of lead 2·318 (corrected for common lead) the Pb/U ratio is 0·0453. Analyses by the Canadian Mines Branch give 0·054.

Barring alteration and other unknown effects the approximate age of the mineral is 344 million years, while the logarithmic formula gives 336 millions.

**2318. Atomic Weights of Radiogenic Leads. G. P. Baxter, J. H. Faull, Jr., and F. D. Tuemmler.** *Am. Chem. Soc., J.* 59. *pp.* 702–705, *April,* 1937.—The atomic weights of certain radiogenic leads are determined.

| *Source* | | *At. Wt.* |
|---|---|---|
| Cerussite, Wallace, Idaho, U.S.A. (common) ... ... ... | | 207·21 |
| Samarskite, Glastonbury, Conn., U.S.A. ... ... ... ... | | 206·34 |
| Pitchblende, Beaverlodge Lake, N. W. T., Canada ... ... | | 206·08 |
| Pitchblende, Katanga, Africa : | Black, insoluble portion... ... | 206·04 |
| | Yellow, HCl-soluble portion ... | 206·05 |

It is pointed out that these values, together with the percentages of important components, point to the presence of several per cent. of common lead in all three radioactive minerals. AUTHORS.

*See also* Abstracts 2284, 2352, 2517, 2527, 2608, 2633, 2642, 2646, 2680, 2681, 2703, 2758, 2777, 2781, 2800, 2807, 2808, 2822.

## COLLOIDS.

**2319. Influence of Ultrasonic Waves on the Colloidal Solubility of Metallic Hydroxides. Part II. N. Sata and S. Watanabe.** *Kolloid Zeits.* 78. *pp.* 277–284, *March,* 1937.—The relationship between ultrasonic-wave peptisation and the purity of iron hydroxide is determined. Cl- and $NH_4$-ions play the chief part, Cl-ions peptise and $NH_4$-ions coagulate. After washing by decantation or treatment in an autoclave $NH_4$-ions can always be detected while Cl-ions can no longer be shown. [For Part I see Abstract 4783 (1935).] J. K.

**2320. Separation of Sol Rubber and Gel Rubber. T. Midgley, Jr. and A. L. Henne.** *Am. Chem. Soc., J.* 59. *pp.* 706–707, *April,* 1937.—Sol rubber prepared by a single diffusion in ether can be separated into two components by fractional precipitation, whereas sol rubber prepared by a single fractional precipitation completely diffuses in ether, thus indicating the superiority of the fractional precipitation method as a means of preparing sol rubber. AUTHORS.

**2321. Coagulation of Acetyl Cellulose Sols. V. A. Kargin and A. A. Stepanova.** *Acta Physicochimica,* 6. 2. *pp.* 183–194, 1937. *In German.*—It is pointed out that the coagulation of lyophilic sols by non-electrolytes in particular have not been sufficiently systematically investigated. Such investigations are of great importance in connection with the wet-spinning of acetate silk. Data and curves are given for the changes in viscosity of acetone solutions brought about by additions of different quantities of water. The changes in osmotic pressure during coagulation are determined as well as the variations in the rate of coagulation due to the additions of gels. Changes in opacity during coagulation are also investigated. The temperature coefficient of the coagulation velocity is also determined. J. K.

**2322. Optical Measurement of Coagulating Powers of Electrolytes. C. V. Jogarao.** *Indian Acad. Sci., Proc.* 5A. *pp.* 193–199, *March,* 1937.—The process of coagulation of arsenic sulphide sol is followed by means of an optical method. By applying this method, the relative coagulating powers of nine electrolytes, namely, chlorides of K, Na, $NH_4$, Ba, Sr, Ca, Al and Fe and HCl are determined. The conclusions drawn are as follows : The coagulating powers of the monovalent chlorides are in the order $HCl > NH_4Cl > KCl > NaCl$, those of the bivalent chlorides are as $CaCl_2 > SrCl_2 > BaCl_2$ and those of the trivalent chlorides are as $FeCl_3 > AlCl_3$. It is also concluded that the final size reached by the colloidal particle as a result of coagulation depends upon the valency of the kation of the coagulator. In the case of the trivalent kations the final size of the colloidal particle is larger than that obtained in the case of the bivalent and the monovalent kations. AUTHOR.

**2323. Electrochemical Experiments on Highly-Purified Lyophilic Sols. W. Pauli and L. Palmrich.** *Kolloid Zeits.* 79. *pp.* 63–77, *April*, 1937.—Gum arabic and silicic acid sols are investigated. Electrodialysis and electrodecantation are used to obtain the purified sols. Conductivity and H-ion determinations are also used. The various reacting acid groups in the different gum-arabic sols are determined by shaking and saturation with $Ag_2O$. The silicic acid sols are likewise electrochemically characterised by their conductivity, measurements of H-ion concentration and by determinations of their Ag-activity and Ag-saturation after shaking with $Ag_2O$. [See Abstract 1678 (1933).] J. K.

***2324. Measurement of pH in Colloid Chemistry. A. Kufferath.** *Kolloid Zeits.* 79. *pp.* 103–107, *April*, 1937.—The paper is a summary of various methods for the determination of pH-values which are applicable to colloid problems. The apparatus designed by several workers in the field is described, together with auxiliary apparatus. F. J. B.

**2325. Electrophoretic Mobility of Purified Tristearin. Part II. A. L. Roberts.** *Faraday Soc., Trans.* 33. *pp.* 643–650, *May*, 1937.—The electrophoretic mobility of purified tristearin is determined as a function of pH in Na salt solutions at different concentrations on the alkaline side of neutrality. The mobility has also been found, mainly on the alkaline side of pH 7 as a function of pH in Ba salt solutions of different concentrations. It is observed that the replacement of the borate anion by an equivalent amount of the chloride ion is without effect upon the mobility at any given value of the pH. The effect of increasing concentration of NaOH upon the mobility of tristearin is observed. It is found that the Ba ion is more effective in reducing the mobility at any value of the pH than are the alkali metal kations. It is concluded that variations in the concentration of the OH-ion are very effective upon the mobility and that in this respect the OH-ion is unique. On increasing its concentration, however, a point of saturation is rapidly attained, after which its behaviour becomes normal. It is also concluded that the H-ion is capable of strong adsorption in the secondary rigid (Helmholtz) layer. [For Part I see Abstract 1432 (1937).] AUTHOR.

**2326. Colloid Optics. Parts I and II. K. S. Ramaiah.** *Indian Acad. Sci., Proc.* 5A. *pp.* 128–137, *Feb.*, 1937.—The paper is concerned with the scattering of light (i) by protein solutions and (ii) by silicic acid sols and gels. For proteins, gelatin, casein and albumin have been used. Depolarisation and intensity of the scattered light are measured simultaneously ; unpolarised, horizontally polarised and vertically polarised incident beams are used. The intensity is a maximum and depolarisation a minimum at the isoelectric point. J. K.

**2327. Diffraction of Light by Colloidal Solutions. A. S. Menon.** *Kolloid Zeits.* 78. *pp.* 272–277, *March,* 1937.—The present paper is concerned with α- and β-stannic acid sols and their effect on the degree of polarisation and intensity of light diffracted by these sols. The α-form is dextro-rotatory while the β-form is not. α-stannic acid sols contain spherical particles, β-stannic acid sols contain non-spherical particles. Particles of α-stannic acid sols are not visible under the ultra-microscope. It is suggested that the differences in behaviour between α- and β-stannic acid sols can only be explained on the basis of their difference in particle size. [See Abstract 4460 (1936).] J. K.

**2328. Mechanically Labile and Stable Structural Viscosity in Gelatin Sol. Wo. Ostwald and W. W. Stuart.** *Kolloid Zeits.* 78. *pp.* 324–338, *March,* 1937.—The viscosity of some sols, notably of gelatin, is known to be affected by mechanical treatment; usually the effect of such treatment is to decrease the viscosity and this the authors call sol-thixotropy (labile viscosity effects). Prolonged treatment leads to a stable viscosity value but it is shown that this elimination of the labile effect can be effected much more rapidly by first subjecting the sol to relatively violent mechanical treatment; thus if the same sol is first driven through a capillary under high pressure, its labile structure is broken down and immediately succeeding runs follow the de Waele-Ostwald rule, according to which $tp^n$ is constant (this rule therefore characterises the stable structure of the sol). Both labile and stable structural viscosity are reduced in the presence of electrolytes (*e.g.*, KCl, $KNO_3$, $Na_2SO_4$) or of free acid ($H_2SO_4$); thus a 1·4 % gelatin sol in the presence of 3*N*KCl has the same viscosity as the equivalent KCl solution and the sol structure is broken down as it would normally be by heating above 40° C. The "stable" structural viscosity increases with age of the sol. The authors give a critical analysis of pre-existing data and conclude with suggestions whereby the "labile" effect might be isolated for study. L. V. C.

**2329. Influence of Salts on Viscosity of Gelatin Solutions. Wo. Ostwald and W. W. Stuart.** *Kolloid Zeits.* 79. *pp.* 49–55, *April,* 1937.—Viscometric measurements of gelatin solutions confirm the views previously expressed regarding hydrophilic and lyophilic sols [see Abstract 4458 (1936)]. J. K.

**2330. Influence of pH on Melting-Point and Swelling of Gelatin Gels. J. H. C. Merckel.** *Kolloid Zeits.* 78. *pp.* 339–341, *March,* 1937.—A method is described for determining melting-points of gels to within 0·2° C. Pure 10 % gels, or the same with additions of NaCl, NaBr, NaI or NaCNS, show melting-points independent of pH from the isoelectric point up to pH 8·6, though falling slightly below the isoelectric point [see Abstract 988 (1937)]. A pure gel shows a minimum swelling in water at the isoelectric point, the swelling increasing more rapidly at lower than at higher values of pH. Maximal swelling was found at about pH 2·8. L. V. C.

**2331. Lyophilic Properties of Cellulose Derivatives. K. Kanamaru and S. Ueno.** *Kolloid Zeits.* 79. *pp.* 77–91, *April,* 1937.—The present paper is concerned with the degree of swelling and the streaming-potential of nitrocellulose in mixtures of various organic solvents. A relationship is found to exist between these two factors. J. K.

**2332. Diffraction of X-Rays by Old Specimens of "Frozen" Rubber. W. H. Barnes.** *Canad. J. of Research,* 15. *Sect. B. pp.* 156–158, *April,* 1937.—Monochromatic X-ray pin-hole diffraction photographs of two old specimens of "frozen" rubber are described. Histories of the specimens are given. Results are compared with existing data for "frozen" rubber and for fresh stretched rubber. Detailed figures for both conditions are thus made available and confirm the reported identity of their diffraction effects. AUTHOR.

**2333. Structure of Semipermeable Membranes of Inorganic Salts. S. Fordham and J. T. Tyson.** *Chem. Soc., J. pp.* 483–487, *March,* 1937.—The structures of semipermeable membranes of the ferrocyanides, hydroxides, "silicates," and tannates of Cu and Pb and tervalent Fe have been examined by electron diffraction. The ferrocyanide membranes were found to be crystalline, and whilst all the crystals exceeded 100 Å in length, many were less than 200 Å; the hydroxides were likewise crystalline. The tannates, on the other hand, were amorphous. It was found, further, that the "silicate" membranes consisted in general of mixtures of gels of crystalline metal hydroxides and amorphous silicic acid. Crystal structures are suggested for Cu and Pb ferrocyanides and for $Pb(OH)_2$ and $Fe(OH)_3$. The results obtained show that the correlation between permeability and pore size as obtained by microscopic methods is fortuitous. AUTHORS.

**2334. Structure of the Cotton Fibre. Wanda K. Farr.** *J. of Applied Physics,* 8. *pp.* 228–232, *April,* 1937.—Cellulose is formed as ellipsoidal particles scattered throughout the viscous living mass of the cytoplasm before the cell membrane is formed. The approximate length of the living cell is given as 1·5 μ, *i.e.,* the length of a single cellulose particle as it exists in the living cell. Since the particles are ellipsoids the shorter axis is given as 1·1 μ. The refractive indices are given as 1·565 lengthwise and 1·530 crosswise respectively. The cellulose membrane is separable into two components physically distinct, *viz.,* the cellulose particles and the cementing material. The cellulose used by nature for membrane construction is in the form of units which maintain their identity through a surprisingly large number of manipulations. S. G. B.

**2335. Moisture in Textiles. A. C. Walker.** *J. of Applied Physics,* 8. *pp.* 261–268, *April,* 1937.—A description of the electrical properties of cotton in relation to moisture content. The formula:—log (insulation resistance) = − A log (% moisture content) + B is valid over a wide range of atmospheric conditions. Close estimates of cotton moisture content are made from swelling data and related to shrinkage. The moisture held and the mechanism of retention is explained on a fundamental basis of fibre structure, whilst the increase in resistance to electricity with decreasing moisture content is due to the lack of continuity of the water channels in the fibre under dry conditions. Sanforising is discussed in relation to prevention of shrinkage, etc. S. G. B.

**2336. Stability of Emulsions. H. M. Cassel.** *Acta Physicochimica,* 6. 2. *pp.* 289–296, 1937. *In German.*—Theoretical. From classical thermodynamic considerations (i) a criterion is derived for the stability of protective (emulsifying) films, in terms of the solubility of the emulsifying agent in the internal and external phases, (ii) the range of stability of protective films of a given curvature is related to the form of the adsorption isotherms, (iii) the mechanism of protective colloids in general is discussed. Qualitative agreement is found on applying the theory to experimental data. L. V. C.

**2337. Ultracentrifugation with Intense Fields. R. W. G. Wyckoff.** *Science,* 85. *pp.* 390–391, *April* 16, 1937.—In respect to the concentration of viruses of various fevers affecting plants and animals, the air turbine drive renders it possible to ultra-centrifuge large volumes of liquids and to carry out analytical procedures. Virus proteins are of high molecular weight and the usual centrifugal fields most advantageous for sedimenting and purifying them do not exceed about 50,000 *g*. The authors have used apparatus, details of which are to be published later which has allowed operation for several hours with a gravity field of 300,000 *g* at speeds of 60,000 r.p.m. B. J. L.

***2338. Inverted Air-Driven Ultracentrifuge. J. W. Beams and F. W. Linke.** *Rev. Sci. Instruments*, 8. *pp.* 160–161, *May*, 1937.—An air-driven ultracentrifuge is described in which the air turbine is below rather than above the large rotor or centrifuge. The centrifuge is mounted inside a vacuum tight chamber on a flexible shaft which extends vertically downward, through an oil gland that seals the vacuum chamber, to the turbine below the chamber. The rotating parts are supported upon an air cushion below the turbine. The turbine is driven by air jets. The rotation of the centrifuge is very smooth and the maximum speed is limited only by the strength of the centrifuge. AUTHORS.

*See also* Abstracts 2361, 2363, 2364, 2377, 2441, 2445, 2697, 2821.

## CRYSTAL STRUCTURE AND PROPERTIES.

**2339. Thomson-Gibbs Equation for Crystals. I. N. Stranski and R. Kaischew.** *Zeits. f. phys. Chem.* 35. *Abt. B.* 6. *pp.* 427–432, 1937.—The Thomson-Gibbs equation for the equilibrium of a simple crystal [see Abstract 4977 (1936)] is now discussed for a large crystal, which for the purpose, is regarded as a collection of small crystals of the desired form and size. The specific surface ($\sigma$), edge ($\kappa$), and corner ($\epsilon$) energies which depend on the crystal size are shown to be connected. This connection is discussed for a quadratic two-dimensional crystal and for one with corner energy which is a function of the crystal size. H. H. Ho.

**2340. Nature of Crystalline Fields in $Er_2(SO_4)_3 \cdot 8H_2O$. F. H. Spedding.** *J. Chem. Phys.* 5. *pp.* 316–320, *May*, 1937.—The splitting of the basic state of $Er_2(SO_4)_3 8H_2O$ due to the presence of the crystalline fields was calculated according to the method of van Vleck, and Penney and Schlapp. Assuming a cubic field, the basic state in the absence of a magnetic field should split into five levels with the relative separations 0, 19, 39, 85, 89 cm.$^{-1}$. Meehan and Nutting have located them spectroscopically at 0, 19, 41 and 85. When the potential field constant D is assumed to be the same as experimentally determined for $Nd_2(SO_4)_3 \cdot 8H_2O$, then there are no arbitrary constants in the calculations, and the calculated over all splitting agrees with the values found within a few per cent. If the true value of D could be used, the deviation would be even less. Similar calculations were made for $Dy_2(SO_4)_3 8H_2O$. While the calculated splitting is of the same order as that found experimentally, the agreement is not good. Reasons for the lack of agreement are given. The magnetic susceptibility expressions for both salts are given and the agreement with experiment in the case of Er is excellent. AUTHOR.

**2341. Electronic Energy Bands in Metallic Calcium. M. F. Manning. and H. M. Krutter.** *Phys. Rev.* 51. *pp.* 761–764, *May* 1, 1937.—Theoretical studies of electronic energy bands in metallic Ca have been carried out by the Wigner-Seitz-Slater cellular method. The conductivity is found to be due to an overlap between the lowest "*s*" band

and the "*d*" band. This overlap leaves a small number of vacant states near the points in the momentum cells whose coordinates are: 0, $\pi/\sqrt{2}R$, $\pi/2\sqrt{2}R$. In terms of the computed results, interpretations of the binding energy, pressure coefficient of resistance, and paramagnetic susceptibility are made. Predictions are made about the Hall coefficient and about optical properties. [See also Abstract 459 (1937).] AUTHORS.

**2342. Energy of the Superlattice in β Brass. N. F. Mott.** *Phys. Soc., Proc.* 49. *pp.* 258–262; *Disc.*, 263, *May* 1, 1937.—An estimate, based on the electron theory of metals, is made of the energy of the superlattice in β brass. The results obtained agree, as regards their order of magnitude, with those for the energy absorbed in the transition from the ordered to the disordered state. AUTHOR.

**2343. Recent Crystallography. W. H. Bragg.** *Roy. Inst., Proc.* 29. 3. *pp.* 484–495, 1937. *Nature*, 139. *pp.* 865–866, *May* 22, and *pp.* 911–913, *May* 29, 1937.—A summary of recent work, chiefly on the structure of proteins, and of alloys, in which X-rays and electron diffraction have been used. W. H. G.

**2344. Alloys. W. L. Bragg.** *Roy. Soc. Arts, J.* 85. *pp.* 431–443; *Disc.*, 443–447, *March* 26, 1937.—A survey is given of recent contributions made by crystal analysis to our knowledge of the nature of the metallic state. The empirical Hume-Rothery Law relating the electron-atom ratio to the crystal structure of an alloy is found to have a theoretical explanation and the phenomena associated with the order-disorder change in the atomic distribution within a structure are discussed. J. T.

**2345. Structure of Cu, Pb, Cd and Sb at High Temperatures. J. E. Dorn and G. Glockler.** *J. Phys. Chem.* 41. *pp.* 499–505, *March*, 1937.—It is shown that the following metals have the lattices indicated in the temperature ranges given: Cu, face-centred cubic, 20°–420° C.; Pb, face-centred cubic, 20°–185° C.; Cd, hexagonal, 20°–120° C.; Sb, rhombohedral, 20°–170° C. In addition, none of the above metals has transitions in the range of temperature investigated, as other authors have postulated. No evidence of metastable forms was found. Sb was analysed by the powder method, and the result was found to agree with that previously obtained by the single crystal method. A simple semi-graphical solution of powder diagrams from rhombohedral, hexagonal, or tetragonal crystals is outlined and applied to the case of rhombohedral antimony. AUTHORS.

**2346. Impurities in Metal Crystals. M. Śmialowski.** *Zeits. f. Metallkunde*, 29. *pp.* 133–135, *April*, 1937.—Large single crystals of Zn and Cu are examined and observations of the impurities present in the crystals produce no support for the assumption that they have a definite and regular "mosaic" structure. The author describes an apparatus for producing large single crystals of Zn. J. I.

**2347. Lattice Dimensions of Electroplated and Normal Chromium. W. A. Wood.** *Phil. Mag.* 23. *pp.* 984–991, *May*, 1937.—A comparison is made of the lattice spacings of pure, electrodeposited, and annealed Cr, employing a technique developed to study the diffuse type of spectral line characteristic of Cr plate. It is shown that the unit cube of the electrodeposited material is greater than that of the pure Cr, and that the expansion persists after ordinary annealing treatment. Quantitative measurements are made of the lattice spacings of the pure and electrodeposited forms. It is concluded that the greater part of the gases codeposited in Cr plating and responsible for its particular properties is adsorbed on the constituent crystallites. [See also Abstract 4074 (1935).] AUTHOR.

**2348. Structural Changes During the Growth of Metal Films. A. G. Quarrell.** *Phys. Soc., Proc.* 49. *pp.* 279–293, *May* 1, 1937.—Electron-diffraction patterns afforded by thin films of face-centred cubic metals prepared by evaporation, electrodeposition, chemical deposition and chemical displacement often show extra rings and bands which may be regarded as typical of the face-centred cubic structure rather than of the metal itself. It is shown that the extra rings are due to the fact that the first deposited layers crystallise in close-packed hexagonal crystals having an axial ratio $c/a$ equal to 1·63, the effective atomic radius being the same as in the normal face-centred cubic form. Further, a gradual transition from close-packed hexagonal to face-centred cubic is postulated, and the prominent band is attributed to the progressive contraction of the (100) hexagonal spacing to the (200) cubic spacing during this transition. Certain very thin evaporated films yield structures intermediate between the hexagonal and cubic modifications, and from this it is inferred that the transition occurs gradually as deposition proceeds, and is not due to an atomic rearrangement occurring when a certain critical film-thickness is reached. These views are supported by the discovery of (i) an electrodeposited Ag film consisting solely of close-packed hexagonal crystals, (ii) a similar Au specimen yielding a pattern in which the hexagonal and cubic diffractions are equally pronounced, and (iii) evaporated Co films consisting mainly of the hexagonal modification, together with a certain amount of the face-centred cubic form. AUTHOR.

**2349. Structure of LaN, CeN and PrN. A. Iandelli and E. Botti.** *Accad. Lincei, Atti,* 25. *pp.* 129–132, *Feb.* 7, 1937.—The preparation of the compounds is described and discussed. The structures, studied by the X-ray powder method, are found to be face-centred cubic, the observed intensities agreeing with those calculated for a NaCl type of structure. The cube edges are $5 \cdot 27_5$, $5 \cdot 01_1$ and $5 \cdot 15_5$ Å for LaN, CeN and PrN respectively. The lattice constant of CeN presents an anomaly in that it is much smaller than that of the Pr compound. Experiments with different samples confirm this low value, and a possible explanation of it is given. The atomic radius of N is calculated and found to be 0·75—0·77 Å compared with the usual value 0·71 Å. C. J. B. C.

**2350. Structure of Lead Titanate. S. S. Cole and H. Espenschied.** *J. Phys. Chem.* 41. *pp.* 445–451, *March,* 1937.—Lead titanate, $PbTiO_3$, was formed in the solid state from PbO and $TiO_2$. The temperature of the initial formation was found to be 360° C. and that of complete formation was 375° C. The specific gravity was found to be 7·52 for powder formed at 800° C., as compared with 7·655 calculated from X-ray data. Lead titanate crystallised as orthorhombic holohedral pyramids from melts. The powder diffraction data are calculated and found to agree with orthorhombic structure with an axial ratio of 0·95 : 1 : 0·92, yielding the size of the unit cell as $a_0 = 4 \cdot 000$, $b_0 = 4 \cdot 211$, $c_0 = 3 \cdot 875$ Å. The space group $D_{2h}^1$ with atomic positions Pb : 000, Ti : $\frac{1}{2}\frac{1}{2}\frac{1}{2}$, O : $\frac{1}{2}\frac{1}{2}0$ ; $\frac{1}{2}0\frac{1}{2}$ ; $0\frac{1}{2}\frac{1}{2}$ was assigned as the most probable arrangement for lead titanate. AUTHORS.

**2351. Nature of Ice. N. J. Seljakov.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 14. 4. *pp.* 183–186, 1937. *In English.*—The result previously obtained [see Abstract 2979 (1936)] that ordinary ice exists in two different modifications, $\alpha$-ice (hexagonal) and $\beta$-ice (rhombohedral), is confirmed and further work is done on the structures of these modifications. It is found that α-ice belongs to one of the following classes of symmetry: $D_{6h}$, $D_6$, $C_{6v}$ and $D_{3h}$; β-ice belongs either to $C_{3i}$ or $C_3$. The lattice sizes are approximately equal and have $a = 4 \cdot 52 \pm 0 \cdot 03$ Å and $c = 7 \cdot 34 \pm 0 \cdot 04$ Å, giving $c/a = 1 \cdot 60 \pm 0 \cdot 02$. The number of molecules in the unit cell is probably 4 in each case. When β-ice is ground and pressed it changes into α-ice. J. T.

**2352. Structure of Complex Salts of Racemic and Optically-Active Cyclohexanediamines with Trivalent Cobalt and Rhodium. Part IV. F. M. Jaeger and L. Bijkerk.** *K. Akad. Amsterdam, Proc.* 40. 4. *pp.* 316–325, 1937.—Continuing the work described in earlier papers of this series [see Abstract 1914 (1937)] the authors give details of the crystal form of some optically-active cobalt salts of tricyclohexanediamine and of ethylenediaminecyclohexanediamine. A table is given showing the rotatary dispersion of one of the salts examined. J. I.

**2353. Crystallographic Study of Fatty Acid Molecules. F. Dupré la Tour.** *J. de Physique et le Radium*, 8. *pp.* 125–129, *April*, 1937.—A study of the structure and of the polymorphism of fatty acids has enabled certain conclusions to be arrived at concerning molecular shape, distribution and equilibrium in the crystalline lattice. It is found that the crystalline form remains almost invariable but that the distribution and equilibrium are modified when the physical conditions, particularly the temperature, are varied. The study of these modifications—notably of some discontinuities which are found in the series of diacids—indicate the relative importance of COOH groups in the crystalline lattice. For equilibrium in the crystalline lattice, two factors are predominant: the forces between chains of C atoms and those due to terminal groups—the former will cause variations with respect to the basal plane of the crystalline lattice and the latter will bring about redistribution of the molecules in a plane normal to their axis. H. H. Ho.

**2354. Crystal Exchange Reactions in Silica Gel. M. A. Miller.** *J. Phys. Chem.* 41. *pp.* 375–378, *March*, 1937.—The formation, movement, and replacement of crystalline iodine and insoluble crystalline iodides in silica gel are examined. The apparent iodide crystal transfer is observed to be identical in its mechanism with that previously described for crystalline iodine. The replacement of crystalline iodine by insoluble crystalline iodide, and *vice versa*, is studied, and it is shown that under certain diffusion conditions pseudomorphic crystals are possible. These appear to possess excellent coherence. It seems apparent that such studies are of value in the interpretation of crystal growth, migration, and replacement in metallic structures, wherein opacity prevents visual observation. AUTHOR.

**2355. Recrystallisation of Al-Mg Alloys. R. Michaud and E. Segol.** *Comptes Rendus*, 204. *pp.* 980–983, *March* 22, 1937.—Billets with impurities 0·07 % are annealed for 4 hr. at 425° C., oil quenched and heavily cold-rolled to reduce the thickness from 6 to 1 mm. The plot of the temperature at which recrystallisation begins, against Mg content, gives an S-shaped curve. This descends slowly to a minimum at 245° C. at 4 % Mg, corresponding to the hardening that sets in from low-temperature annealing following cold-work. It then rises due to β precipitation and finally tails off at about 350° at 11 % Mg. About 4 % Mg the two effects balance. From Debye-Scherrer measurements on quenched alloys, the plot-lattice constant against % Mg is a straight line. For quenched and tempered alloys in which recrystallisation is beginning, the curve tails off. From the interval separating the two curves the Mg remaining in solid solution is

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determined. The values obtained correspond exactly with the solubility at the given temperature as shown on the equilibrium diagram, *i.e.*, precipitation is practically complete when recrystallisation sets in. D. R. H.

**2356. Ultramicroscopic Observations on Photosensitive Crystals. Part IV. K. Schaum and O. Scheld.** *Zeits. f. wiss. Phot.* 36. *pp.* 121–140, *May–June*, 1937.—There are two kinds of binary crystal systems, mixed crystals and intergrowths. The formation of mixed crystals is generally determined by Grimm's conditions, *viz.*, similarity of type, of crystal spacing, of chemical behaviour. But there are notable exceptions to this. The various kinds of mixed crystal systems are discussed at great length as well as the factors which appear to determine the resulting crystal form in those cases where this is different for the two components. Intergrowths appear to form where mixed crystals are prevented either by the operation of Grimm's conditions or by the method of preparation. They may consists of (*a*) regular intergrowths such as layering and (*b*) of irregular intergrowths which are described as agglomerates or as ingrowths. The possible causes of the changes which occur as the result of the entry of a light sensitive substance such as AgCl into a binary crystal system are discussed. These may be: alteration of concentration, deformation centres, rearrangement of reaction partners, deformation of electron shells and changes in chemical binding. Intergrowths are important in photographic materials, *e.g.*, inclusions of Ag, $Ag_2S$ and dyestuffs affect the sensitivity of AgBr, etc. The preparation of a large number of mixed crystals and intergrowths mostly containing silver salts, from melts and from solution, is described briefly and the results of investigation on the light sensitivity of these is described. A summary is given showing the results of microscopic observation on a number of binary systems. The existence of ultramicroscopic particles after illumination has been found in many cases. [For Part III see Abstract 471 (1937).] J. E.

*See also* Abstracts **2315, 2333, 2360, 2596, 2683, 2684, 2688, 2692, 2694, 2705, 2718, 2733, 2756, 2783, 2785, 2793, 2811, 2812, 2820, 2827.**

## DENSITY.

**2357. Specific Gravity Correction Factors for Petroleum Oils. E. S. L. Beale.** *Inst. Petroleum Technologists, J.* 23. *pp.* 213–219, *March*, 1937.—The well-known Bureau of Standards Circular No. 154 has been taken as the basis for the calculation of a standard table of specific gravity correction factors, which are shown to give the same results when used in the ordinary way as the elaborate tables in the Circular. The method adopted has been to calculate the mean correction over the temperature range 60° to 120° F. from the tables for oils of S.G. 0·726 and heavier, and over the range 60° to 90° F. for oils lighter than 0·726. These values were plotted on a large-scale graph, and this was then divided into steps of 0·00001 per ° F., and the range of S.G. over which each of these is applicable was read from the curve. Attention is direction to the additional errors introduced by the use of the Abridged Volume Correction Table issued by the A.S.T.M., which is based on the same data as Circular No. 154, and also the errors which may be caused by a considerable change in the apparent value of the correction factors of waxy oils at low temperatures. AUTHOR.

**2358. Density and Molar Volumes of Solutions. Part I. O. K. Skarre, S. G. Demidenko and A. E. Brodsky.** *Acta Physicochimica*, 6. 2. *pp.* 297–305, 1937. *In German.*—The densities of dilute solutions of KCl and urea are determined at 25° C. by comparison with water by means of Washburn and Smith's differential pyknometer. From the determined densities and the concentrations of the solutions used the molar volumes are calculated. The results for KCl are in agreement with Debye and Hückel's theory. Those for urea form a smooth curve with Dikowa's results for slightly greater concentrations. Urea behaves similarly to cane sugar. P. H. B.

*See also* Abstracts 2350, 2447, 2449, 2715.

## DIFFUSION AND OSMOSIS.

**2359. Mathematical Description of the Diffusion Double Layer. A. Voet.** *Kolloid Zeits.* 79. *pp.* 15–18, *April,* 1937.—The theory of the diffusion double layer which was proposed by Gouy, describes the spatial ionic distribution at a phase boundary, and some results of this theory are now considered [see Abstract 545 (1935)]. It is found that the application of the so-called Debye-Hückel approximation to the potential calculation in the diffusion double layer is entirely inadequate; also the assumption of a spherical shape for the evaluation of the particle radius is in general meaningless for the potential evaluation of the double layer, and that only the curvature of the particles is a decisive quantity. In general, only the formula of the plane double layer is required for calculation purposes, but exceptions occur with very small particles in extremely dilute solutions. There are grave objections to the application of the usual double layer formula to non-homogeneous surface charges. H. H. Ho.

**2360. Penetration of Nickel Ions into Rock-Salt. I. A. Parfianowitsch and S. A. Schipizyn.** *Acta Physicochimica,* 6. 2. *pp.* 263–274, 1937. *In German.*—It has been established that Ni can penetrate into rock-salt both by electrolysis and by diffusion. Methods have been developed for identifying Ni in rock-salt, and the dependence of the mobility of the Ni ions in the rock-salt on the temperature has also been investigated. It has been found that the U-electrons in rock-salt can unite with the Ni ions which have penetrated into the salt. Full experimental details are included. H. H. Ho.

**2361. Absorption and Diffusion of Water in Rubber. H. A. Daynes.** *Faraday Soc., Trans.* 33. *pp.* 531–544, *April,* 1937.—A new differential equation of diffusion is proposed to represent the movements of water vapour through rubber according to the osmotic theory of absorption. The differences between the absorption of a gas and of water vapour by rubber are confirmed. The results obtained are inconsistent with the simple gas-diffusion theory which is often assumed to apply to water in rubber. J. K.

**2362. Diffusion in Liquids. Part XI. T. Linhart.** *Zeits. f. Physik,* 105. 1–2. *pp.* 45–55, 1937.—Use is made of the micro-method of Sitte [see Abstract 74 (1935)] whereby the diffusion of a coloured liquid into a colourless liquid is followed quantitatively by photometric measurement of the absorption of light. Experiments are made upon the diffusion of dilute solutions of some coloured electrolytes [$KMnO_4$, $CoCl_2$, $Co(NH_3)_4(NO)_2Cl$] into water and dilute solutions of some colourless electrolytes (HCl, KOH, KCl). The results obtained are in agreement with the theory of Sitte. L. A. W.

**2363. Osmotic Pressure of Colloidal Solutions. W. Haller.** *Kollid Zeits.* 78. *pp.* 341–343, *March,* 1937.—Theoretical. An expression is derived for osmotic pressure, containing two terms, of which the first alone (proportional to log concentration) is important at very low concentrations, while the second (containing higher-powers of log $c$) becomes increasingly important with increasing $c$; the latter term is interpreted as "swelling pressure." L. V. C.

**2364. Osmotic Pressure of Solutions of Substances of High Molecular Weight. O. Kratky and A. Musil.** *Zeits. f. Elektrochem.* 43. *pp.* 326–336, *May,* 1937.—It is shown from the general theory of solutions that the osmotic pressure expression consists of (*a*) an entropy term which contains the logarithm of the molar fraction, (*b*) an energy term connected with the heat of dilution of the system, and (*c*) additional energy terms which are related in a definite manner with the deviation of such quantities as volume, specific heat, etc., from additive relations on dilution. For ideal solutions the osmotic pressure is given by the logarithmic term alone, but for actual solutions (*b*) and (*c*) have varying rôles, and it is shown possible to connect deviations from the van't Hoff law with the terms of (*b*) and (*c*). Application is then made to substances of high molecular weight and parallels are pointed out between the behaviour of solutions of substances of high and low molecular weights at equal concentrations. The comparison of homologous polymers of one substance indicates a dependence on molecular length, *i.e.*, on the fibre character of the molecule (length, shape, mobility, etc.), and the nature of the increment due to increasing molecular weight is discussed. In a short review of the investigations of Wo. Ostwald the authors indicate their formal agreement with his empirically derived expression, and point out that his sol-swelling corresponds with their reciprocal interaction terms. H. H. Ho.

*See also* Abstracts 2333, 2723.

## ELASTICITY AND PLASTICITY.

**2365. Deformation of Elastic Ring (Plane Problems). L. Beschkine.** *Comptes Rendus,* 204. *pp.* 1161–1164, *April* 19, 1937.—Michell has given a fairly general solution of the problem of the deformation of an elastic ring subjected to forces applied to its internal and external surfaces [see *Proc. London Math. Soc.*, 1899, vol. 31, p. 100]. Michell's solution is only valid for the case when the resultant force on the ring is zero. The forces being developed in Fourier series developed in terms of $\theta$, the polar angle of a point on the ring, Michell's solution is valid for any terms in $\sin n\theta$ and $\cos n\theta$, except when $n = 1$. The author here supplies the solution for the case in which normal and tangential forces, $N_1 \cos \theta$, $T_1 \sin \theta$ and $N_2 \cos \theta$, $T_2 \sin \theta$ are applied to the inner and outer surfaces of a ring of respective radii $R_1$ and $R_2$. J. S. G. T.

**2366. Strain Ellipsoid. A. Leith.** *Am. J. Sci.* 33. *pp.* 360–368, *May,* 1937.—The concept of the strain ellipsoid is described and analysed with the dual purposes of suggesting how it may be used profitably in solving structural problems, and of directing attention to certain misuses of the strain ellipsoid which reflect misunderstanding of its true meaning. AUTHOR.

**2367. Points of Congestion in the Periodontal Membrane. J. L. Synge.** *Phil. Mag.* 23. *pp.* 885–897, *May,* 1937.—The paper contains five sections: (1) Introduction. (2) Equations for the Normal Membrane. (3) Equilibrium of a Tooth when Congestion is present. (4) Points of Congestion. (5) The Case of a Membrane of Constant Thickness on a Conical Root. [See also Abstract 2736 (1933).]

**2368. General Proof of Saint-Venant's Principle. J. N. Goodier.** *Phil. Mag.* 23. *pp.* 607–609, *April*, 1937.—By consideration of the order of magnitude of the strain energy, it is shown that the dimensions of the region over which a self-equilibrating system of tractions acting over a small area of the surface of an elastic solid has an appreciable effect are comparable with the dimensions of this area. W. G. B.

**2369. Thermal Stress in Long Cylindrical Shells. J. N. Goodier.** *Canad. J. of Research*, 15. *Sect. A. pp.* 49–58, *April*, 1937.—The thermal stress in thin-walled cylinders of any cross-section has been investigated for internal and external temperatures each varying in any manner round the circumference but not in the axial direction. The thickness also may vary round the circumference. A method is given for calculating the stress from given temperature distributions, whatever the shape of the cross-section. The stress is evaluated for uniform, but different, inside and outside temperatures. The circular cylinder is treated in detail and the stress found for the general case of circumferential variation. It is shown that the maximum stress will depend only on the temperature distributions and the material, and not on the thickness or diameter of the cylinder. AUTHOR.

**2370. Integration of Thermoelastic Equations. J. N. Goodier.** *Phil. Mag.* 23. *pp.* 1017–1032, *May*, 1937.—Solutions are developed of the equations for stress and strain, in an elastic solid, due to uneven heating, the temperatures being either arbitrary or governed by the law of heat conduction. It is proved that the stress will be discontinuous where the temperature is discontinuous, and the amount of the discontinuity is evaluated and found to depend only on the temperatures at the point considered. The theorem is applicable to the shrink fits of engineering practice. The fundamental problem of a heated element of volume, of arbitrary shape, in an otherwise cold infinite solid is solved and the solution represented as a centre of dilatation. Concentration of thermal stress is illustrated in a discussion of the infinite plate with elliptical and rectangular heated areas. A complete solution is given for the heating or cooling of the solid cylinder (temperatures independent of the axial coordinate). AUTHOR.

**2371. Compressibility of Liquids and a Method of Obtaining the Compressibility of Molecules. D. B. Macleod.** *Faraday Soc., Trans.* 33. *pp.* 694–707, *May*, 1937.—The volume of a liquid under pressure can be presented with considerable accuracy by one or other of the following equations:

$$(a)\ V_p = \pi_0(v_0 - b) / (P_e + \pi_p) + V_0 - B(P_e + \pi_p) + C(P_e + \pi_p)^2$$

where $P_e$ = external pressure, $v_0 - b$ = the free space. In this paper $v_0 - b$ has been calculated from data independent of that to which it is subsequently applied—namely from viscosity data. $\pi_0 = RT_0/(v_0 - b)$, and $\pi_p = \pi_0(v_0/v_p)^2$, where $v_0$ and $v_p$ are the experimental volumes. $V_0$ = the volume of the molecules in 1 c.c. of the substance at 0° C. when in the gaseous condition and B and C are constants proportional to the compressibility of the molecules and to the change of compressibility with pressure respectively.

$$(b)\ V_p = \pi_e(v_e - b)/(P_e + \pi_p) + K/(P_e + \pi_p + P_m) + b_a.$$

where $P_m$ = the internal pressure of a molecule, $b_a$ = the volume of the atoms in the molecule, K = a constant for a particular molecule at a constant temperature. If applied to a gram molecule, the value of K does not vary markedly for different organic substances. In each of these equations there are three arbitrary constants, to each of which a definite physical meaning has been attached. Of these two equations, the latter gives the better agreement between observed and calculated values.

AUTHOR.

**2372. Antiplane Stress in an Elastic Solid. L. N. G. Filon.** *Roy. Soc., Proc.* 160A. *pp.* 137–154, *May* 1, 1937.—A stress system for which the stresses, $xx$, $yy$, $xy$, in the plane of $xy$, all vanish may be referred to briefly as "antiplane" stress. Such a type of stress includes simple tension parallel to $z$, flexure under constant bending moment, and de Saint-Venant's solutions for torsion and flexure. It is shown that it also includes a type of solution which appears to have been hitherto overlooked, in which the stresses reduce to $xz = -\partial\phi/\partial x - \frac{1}{2}Px$, $yz = -\partial\phi/\partial y - \frac{1}{2}Py$, $zz = Pz$, $\phi$ being a harmonic function. The characteristics of this solution are investigated in the case of a cylinder whose axis is parallel to the axis of $z$. It is proved to involve internal pulls along axial fibres, or longitudinal shears along the curved surface of the cylinder. The function $\phi$ is determined in simple cases and four examples are given where, by combination with known systems of plane strain or plane stress, such an antiplane stress provides the solution of certain practical problems, in which a long circular cylinder is forced through axially against the friction of constraints.

AUTHOR.

***2373. Method of Measuring Modulus of Elasticity and Logarithmic Decrement. F. Förster.** *Zeits. f. Metallkunde,* 29. *pp.* 109–115, *April,* 1937.—The measurement of the characteristic frequencies and the log. dec. of rods of any shape is discussed; particular reference is made to the determination of the log. dec. from rate of decay and resonance curves and to the influence of the mode of suspension as well as to the means adopted to minimise direct mechanically (or electrically) transmitted vibrations. After a careful analysis of the sources of error in the apparatus generally used, an instrument has been designed which will faithfully record the characteristic frequencies and log. dec. of any vibrating body. In principle, it consists of a transmitter and receiver, the former serving to generate mechanical vibrations in the body (mounted in a vibrationless support) whilst the receiver picks up these vibrations, converts them into electrical oscillations and amplifies them to such an extent that a record of them may be obtained on a suitable recording instrument. The transmitter consists of a type of heterodyne oscillator, the difference in frequency of the 2-valve generators being variable over a wide range. The electrical oscillations are converted into mechanical vibrations (and vice versa) by means of a permanent magnet speaker adopted for the purpose. For bodies with a small log. dec., *e.g.,* a steel rod, the fundamental frequency may be determined to an accuracy of 1/100 per sec. when the fundamental is 1000 per sec.; this corresponds to a variation in elastic modulus of 0·02%. The log. dec. may be determined to an accuracy of about 2%. [See following Abstract.] H. J. H. S.

**2374. Effect of State of Materials on the Elastic Modulus and Logarithmic Decrement. F. Förster and W. Köster.** *Zeits. f. Metallkunde,* 29. *pp.* 116–123, *April,* 1937.—The elastic modulus and log. dec. of Fe, Ni, Cu, Mo, Al, Mg, Zn, Cd, Pb and Sn are determined with the aid of the apparatus described above [see preceding Abstract] when the test sample is weakly excited. In all the metals mentioned, the modulus decreases with temperature, as long as the mechanism of slip remains unaltered. The log. dec. increases with temperature and if the mechanism of slip changes (as in Mg at 225° C. and in Al between 300 and 400° C.) a rapid increase results. A change in the modulus occurs on transformation of the material (usually the change begins just prior to the transformation). Ferromagnetics have a relatively higher log. dec. which usually decreases with temperature below the Curie point but increases above it. The effects of cold annealing, hardening, recrystallisation and corrosion on the modulus and log. dec. are described. Attention is drawn to the value of measurements of the log. dec. as a non-destructive method of testing materials. H. J. H. S.

**2375. Effect of Temperature on the Consistency of Asphalts. H. G. Nevitt and L. C. Krchma.** *Indust. and Engin. Chem.* (*Analytical Edition*), 9. *pp.* 199–122, *March* 15, 1937.—The formula given is $S = 0{\cdot}221 \log [\log (\mu_1 + 0{\cdot}8) / \log (\mu_2 + 0{\cdot}8)] / \log (T_2/T_1)$, where S is the viscosity-temperature susceptibility coefficient and $\mu_1$ and $\mu_2$ are the kinematic viscosities at absolute temperatures $T_1$ and $T_2$. S is applicable to a wide range of temperatures and viscosities and can be graphically determined. [See also Abstract 1982 (1936)] and following Abstract.] J. K.

**2376. Viscosity-Temperature Susceptibility of Asphalt. S. Mason, R. J. Loomis, S. D. Patterson, H. G. Nevitt and L. C. Krchma.** *Indust. and Engin. Chem.* (*Analytical Edition*), 9. *pp.* 138–139, *March* 15, 1937.—Using the standard Saybolt viscometer it is concluded that the viscosity-temperature susceptibility coefficient is a suitable index to use at the present stage of asphalt technology. [See preceding Abstract.] J. K.

**2377. Rheological Properties of Asphalts. Part IV. C. E. Coombs and R. N. Traxler.** *J. of Applied Physics*, 8. *pp.* 291–296, *April*, 1937.—Observations have been made on the anomalous flow characteristics of air-blown asphalts. Data obtained by the rotating cylinder type of viscometer at a low shearing stress show the presence in an asphalt of elastic fore- and after-effects. Several manifestations of thixotropy are shown. Correlations of the Bingham-Stephens alternating stress, the falling coaxial cylinder and the conicylindrical rotation viscometers have been made, at essentially the same mean shearing stresses in all three instruments for a particular asphalt. [See also Abstracts 1982 (1936) and 1495 (1937).] J. K.

**2378. Viscosity, Elasticity and Plastic Strength of Soft Materials (Flour Dough). Part IV. R. K. Schofield and G. W. S. Blair.** *Roy, Soc., Proc.* 160A. *pp.* 87–94, *May* 1, 1937.—Experiments are described which support the view that in a flour dough the gluten forms an elastic network which dominates the mechanical behaviour. It appears that when a cylinder of dough is first stretched some of the links in the network are ruptured since it will not return to its original length. Enough remain unbroken, however, for a continuity of structure to be preserved until the cylinder has been extended to 5 or 6 times its original length. The "work hardening" of dough is thus accounted for. The elastic network does not establish itself at once, but continues to build up for some time after the dough is mixed. Its strength is greatly reduced by drastic remixing of the dough but is largely recovered on further standing. The addition of HCl in slight excess of the acid binding capacity destroys the strength of the network. This shows that the electrostatic attraction between oppositely charged groups in neighbouring molecules is an important factor in the strength of the gluten network. The upward

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bend of the reloading curve up to the point where flow (*i.e.*, the rupture of further links) occurs is probably mainly due to the irregularity of assembly of the elastic members, but may also indicate that individual chains are approaching the limit to which they can be extended. Evidence has been obtained that the starch paste penetrating the gluten network has a " yield value," in consequence of which there is elastic hysteresis even when the cycle is carried out slowly enough to avoid elastic after-effect. [For Part III see Abstract 3911 (1933).] AUTHORS.

**2379. Wave Propagation in Imperfectly Elastic Systems. G. Oberti.** *Accad. Lincei, Atti,* 25. *pp.* 37–43, *Jan.* 3, 1937.—The case is considered of a continuous solid in its natural state which is under the influence of an external system which brings it into a state of compulsion. The material of the solid is such that it is not perfectly elastic in Hooke's sense, but yields under force, flowing slowly with time. Such a body may be called imperfectly elastic. The mathematical discussion leads to the result $2V = \sqrt{v_n^2 + 4G/\rho} - v_n$; where V = velocity of propagation of the surface of the wave, $v$ = velocity of the medium at a point P which is the generating point of the wave surface at an instant $t$ and $v_n$ the component of the velocity along the normal $n$, and G the tangential elastic modulus. This formula governs the propagation of the wave in elastic-viscous systems. If $v_n = 0$ it is the same as the known elastic formula, while for $V = 0$ it conforms with the known negative result for the case of a system perfectly viscous. V is always less than the velocity in the equivalent purely elastic medium, or in that holding in the region of the medium not subject to flux. J. J. S.

**2380. Propagation of Motion in Cords. B. Finzi.** *Accad. Lincei, Atti,* 25. *pp,* 82–85, *Jan.* 17, 1937.—A cord, flexible and inextensible, subject to two opposed forces applied to its extremities has a rectilinear configuration of equilibrium and the tension T at every point of the cord is equal to the force applied at an extremity. The *small* transversal displacements relative to the *small* movements of the cord are functions of the time $t$ and of the abscissa $x$ of the point to which they are referred. This leads if the cord is homogeneous to the well-known expression of the constant $v$ which represents the velocity of propagation of the motion along the cord: $v = \sqrt{T/k}$, where $k$ = the mass per unit of length of the cord. The present paper deals with the case where the cord is subjected not only to two opposed forces applied at its extremities, but also to forces distributed over its length. The configuration of equilibrium of the cord will then be no longer rectlinear but curvilinear. A mathematical discussion is given of the question how under these conditions a general finite motion is propagated along the cord. J. J. S.

**2381. Theory of Relaxation Oscillations. J. Haag.** *Comptes Rendus,* 204. *pp.* 932–934, *March* 22, 1937.—The analysis contained in a previous paper [see Abstract 1013 (1936)] has been developed to yield more accurate results. A brief *resumé* of analytical results relating to arcs of the first and second classes is given. J. S. G. T.

**2382. Damping of Torsional Oscillations in Quartz Fibres. G. A. Downsbrough.** *Phys. Rev.* 51. *pp.* 877–883, *May* 15, 1937.—The results obtained by previous workers have been qualitatively confirmed, but it was demonstrated that many of the perplexing features were characteristic of the material used to mount the quartz fibres, and not of the fibres themselves. When fused quartz joints were substituted, these features were eliminated, and in addition the damping became very much smaller than in any previous work. As a result, it was also necessary to investigate energy losses hitherto unimportant; several were found capable of affecting the results, but in the final arrangement they were all insignificant. On the assumption that the damping is a purely viscous phenomenon, it is shown that the product of the period of oscillation and the logarithmic decrement should be a constant of the material. This was experimentally verified over a small range of periods; the value obtained was $1 \cdot 3 \times 10^{-5}$. The coefficient of viscosity for quartz, derived from this, is $2 \cdot 2 \times 10^{5}$ g/cm. sec. AUTHOR.

**2383. Bursting Pressure on Test Glass Bottles. A. Cousen.** *Soc. Glass Technol., J.* 21. *pp.* 187–195, *April*, 1937.—Rapid, or so-called snap bursting pressure tests are affected by the rate of pressure increase as well as by the method of support of the bottle, results tending to favour the smaller bottle. Sustained pressures of any desired amount up to about 700 lbs./in$^2$. can be easily and accurately applied by means of an apparatus designed by F. W. Preston. This instrument can be used either for dead-line testing, or as a check on a more rapid snap test machine. Results from the sustained pressure tests decrease with increasing time of application of the pressure, the effect of fatigue being clearly shown. By means of the Preston machine the higher values for bursting pressure obtained in snap tests from bottles annealed in open lehrs as compared with those annealed in muffle lehrs are confirmed in cases where the pressure is applied for definite periods of time. AUTHOR.

*See also* Abstracts 2446, 2483, 2827.

## GRAVITATION.

**2384. Inverse Square Law of Gravitation. Parts II and III. E. A. Milne.** *Roy. Soc., Proc.* 160A. *pp.* 1–36, *May* 1, 1937.—In Part II by purely kinematic methods, the law of gravitation is obtained in relativistic form in the flat space of any fundamental observer using the *t*-dynamics. An expression is found for the mutual potential energy $\chi$ of any two massive particles. It is Lorentz-invariant, and it reduces under appropriate choice of observer to the Newtonian potential energy with a " constant of gravitation " proportional to the epoch $t$. It is used to calculate the " attraction," force and acceleration experienced by a particle $m_1$ in the presence of a particle $m_2$. The attraction is shown to be accurately describable by an inverse square law, provided the distance is measured by the fundamental observer coinciding with the attracting particle. The conditions of validity of the law of equality of action and reaction are obtained. The equations of motion of a pair of particles are obtained, and applied to the problem of the orbit of a particle in the presence of a nebular nucleus. It is shown that the orbits are equiangular spirals in the *t*-dynamics but appear as Keplerian orbits in the $\tau$-dynamics and the generally spiral character of resolved galaxies is accounted for. Sundry velocity-features of the motions observed in our own galaxy are explained. In Part III the law of gravitation for any two particles of masses $m_1$ and $m_2$, as previously derived, is expressed in $\tau$-measure, *i.e.*, in a form appropriate to the public hyperbolic space $d\epsilon^2$ in which the system of nebular nuclei appears as at relative rest. For two particles separated by coordinate distance $\lambda$, the potential energy $\chi$ is given by

$\chi = -(m_1 m_2 c^2/M_0)/\tanh(\lambda/ct_0) = -\gamma_0 m_1 m_2/ct_0 \tanh(\lambda/ct_0)$, where $\gamma_0$ is a constant $c^3 t_0/M_0$ equal to the Newtonian constant of gravitation. This reduces to the Newtonian expression for $\lambda \ll ct_0$. $\chi$ satisfies Laplace's equation in hyperbolic space, and yields the inverse square law of attraction with the appropriate modification for hyperbolic space. The relativistic form of the equations of motion for the two-body problem is obtained, and certain cases are discussed. The present account of dynamics and gravitation, constructed by purely kinematic methods, is recapitulated. [For Part I see Abstract 3460 (1936).] AUTHOR.

*See also* Abstracts 2429, 2432.

## HYDRODYNAMICS AND AERODYNAMICS.

**2385. Vortex Theory of the Screw. D. Riabouchinsky.** *Comptes Rendus,* 204. *pp.* 934–937, *March* 22, 1937.—The author points out that his theory relating to the pressure exerted on a helical sector rotating in a fluid is sometimes erroneously attributed to Joukowsky. The increase of resistance experienced by a disc owing to its rotation in fluid is here discussed. J. S. G. T.

**2386. Influence of the Ground on Lifting Screws. A. Betz.** *Zeits. f. angew. Math. u. Mechanik,* 17. *pp.* 68–72, *April,* 1937.

**2387. Application of Hodographic Methods to Dynamics of Gases. A. Busemann.** *Zeits. f. angew. Math. u. Mechanik,* 17. *pp.* 73–79, *April,* 1937.—Application of the hodograph method, in which the velocity of a moving point is represented both in magnitude and direction by a curve, has been made to problems relating to the flow of gases by Molenbrock (1890) and Tschapligin (1904). Detailed reference is made to the results of these early treatments, and to the advantages possessed by this method for dealing with such problems. By way of an example the method is used to study the flow of gas through an opening of specified shape. R. W. P.

**2388. Method of Electrical Analogies Applied to the Calculation of Corrections Due to [Wing] Surfaces. L. Malavard.** *Comptes Rendus,* 204. *pp.* 1052–1054, *April* 5, 1937.—The method of electrical analogies previously described by the author [see *La Science aérienne,* 6. *p.* 360, *Nov.–Dec.,* 1936] for the calculation of aeroplane-wing surfaces is applied to derive corrections attributable to the force associated with vortices generated by the wing surface. The method is illustrated by the comparison of the cases of a wing in a stream of fluid which may be either limited or boundless. J. S. G. T.

**2389. Boundary Layer Equations. D. R. Hartree.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 223–239, *April,* 1937.—The differential analyser has been used to evaluate solutions of the equation $y''' = -yy'' + \beta[y'^2 - 1]$, with boundary conditions $y = y' = 0$ at $x = 0$, $y' \to 1$ as $x \to \infty$, which occurs in Falkner and Skan's approximate treatment of the laminar boundary layer [see Abstract 1081 (1932)]. A numerical iterative method has been used to improve the accuracy of the solutions, and the results show that the accuracy of the machine solutions is about 1 in 1000, or rather better. It is shown that the conditions are insufficient to specify a unique solution for negative values of $\beta$; a discussion of this situation is given, and it is shown that for the application to be made of the solution the appropriate condition is that $y' \to 1$ from below, and as rapidly as possible, as $x \to \infty$. The condition that $y' \to 1$ from below can be satisfied only for values of $\beta$ greater than a limiting value $\beta_0$, whose value is approximately $-0{\cdot}199$, and which is related to the point at which the laminar boundary layer breaks away from the boundary. AUTHOR.

**2390. Calculation of Lift Distributions of Aerofoils. R. C. J. Howland.** *Phil. Mag.* 23. *pp.* 731–744, *April*, 1937. *Supplement.*—New methods are given for solving approximately Prandtl's integral equation for a given aerofoil, based on using $K = Va_0c\alpha$ as a first approximation ($K$ = circulation, $V$ = velocity of aerofoil, $a_0$ = slope of lift-incidence curve, $c$ = chord, $\alpha$ = incidence). A new analysis is developed to fit a finite Fourier odd sine series, with coefficients to be evaluated, to the values of $K/(4sV)$ at a finite number of equally spaced values of $\theta$ between 0 and $\frac{1}{2}\pi$, where $x = -s\cos\theta$ ($x$ = distance along span from central section, $s$ = semi-span). The computations necessary can be to a large extent standardised, and use made of tables of certain coefficients. When the number of ordinates is large, the method should have a considerable advantage over Glauert's method. But the ordinates are still irregularly spaced. An alternative method is developed with equally-spaced ordinates in which $K$ is represented by a series of parabolas. S. G.

**2391. Prandtl's Theory of the Aerofoil. H. Schmidt.** *Zeits. f. angew. Math. u. Mechanik*, 17. *pp.* 101–116, *April*, 1937.—By a method due to E. Trefftz, the problem of finding the distribution of circulation or lift along the span in Prandtl's approximate theory of the aerofoil of finite span (in which the aerofoil is replaced by a lifting line) may be reduced to the solution of the third boundary problem of potential theory in a plane, with boundary conditions at a line. After conformal transformation into the unit circle, the circulation may be expanded in a Fourier series, whose coefficients, which satisfy an infinite system of linear equations, may be found by a method due to E. Schmidt, the cases of piecewise continuous distributions of chord length and incidence over the span included. For a certain class of distributions of chord, however, a solution may be obtained in closed form by the use of known methods of function theory. S. G.

**2392. Transition from Subsonic to Supersonic Flow. W. Tollmien.** *Zeits. f. angew. Math. u. Mechanik*, 16. *p.* 370, *Dec.*, 1936, *and* 17. *pp.* 117–136, *April*, 1937.—The steady two-dimensional irrotational motion of a gas obeying the adiabatic law is studied in general orthogonal coordinates, and the conditions sought that the velocity components should be functions of one coordinate only. It is found that the velocity components can be constant along logarithmic spirals or along straight lines of a certain family. The case of logarithmic spirals is discussed in detail, with a new discussion of the limiting case when the spirals become concentric circles, corresponding to a motion already considered by G. I. Taylor, and also by H. Bateman. In almost all the motions considered there are certain limiting curves in the supersonic region beyond which it is not possible to continue the motion in the manner considered, with the velocity components functions of one (generalised) coordinate only. At these limiting curves the pressure is constant, the normal pressure gradient infinite, and the normal velocity gradient equal to the local velocity of sound. The limit curves are envelopes of Mach-waves. S. G.

***2393. Response of a Vane Anemometer to an Air-Stream of Pulsating Speed. E. Ower.** *Phil. Mag.* 23. *pp.* 992–1004, *May*, 1937. —The behaviour of a vane anemometer in a pulsating air-stream is examined theoretically. It is shown that the anemometer over-estimates the average air-speed, and an expression is given for the magnitude of the error in an air-current whose speed pulsations follow a sine law. In order that the equation of motion may be integrable analytically a small term is neglected, and this step is shown to be justified by comparing the approximate solution with the results of numerical integration of the complete equation of motion. The response of a particular vane anemometer to a pulsating air-stream has been observed in the wind tunnel, and the results of the experiments confirm the theoretical conclusions. AUTHOR.

**2394. Flow around a Cruciform Obstacle. L. Sona.** *Accad. Lincei, Atti*, 24. *pp.* 508–515, *Dec.* 20, 1936.—Continuing the work of a previous paper [see Abstract 1938 (1937)] the forces acting on a cruciform obstacle in a translatory current are examined. There is a transverse reaction, *i.e.*, one normal to the direction of the current, and in general a direct reaction which may be positive or negative. The moment about the point where the laminæ, forming the object, cross is investigated, and there are positions of stable and unstable equilibrium. If the laminæ cross at right angles, the moment is always zero. W. A. R.

**2395. Statistical Theory of Turbulence. T. v. Kármán.** *Nat. Acad. Sci., Proc.* 23. *pp.* 98–105, *Feb.*, 1937.—G. I. Taylor [see Abstract 4101 (1935)] introduced the concept of isotropic turbulence, the correlation function $R(y) = \overline{u_1 u_2}/\overline{u^2}$ ($u_1$, $u_2$ are simultaneous values of $x$-components of turbulent velocity at a distance $y$ apart perpendicular to the $x$-axis), and the length $\lambda$ (a measure of the size of the smallest eddies), such that $2\lambda^{-2} = -(d^2R/dy^2)$ at $y=0$. For the decay of turbulence behind grids $U d\overline{u^2}/dx = -10\nu\overline{u^2}/\lambda^2$. Taylor found $U/\sqrt{(\overline{u^2})} = \text{const.} + \text{const.}\ x/U$, by taking $\lambda/M = \text{const.}\ \sqrt{[\nu/M\sqrt{(\overline{u^2})}]}$. ($U$ = mean stream velocity, $M$ = mesh of grid.) This last equation is here criticised. Starting from the equation for the vorticity it is found that $d\overline{\xi^2}/dt = -10\nu\,\overline{\xi^2}/\lambda_\infty^2$, where $\overline{(\partial\xi/\partial y)^2} = 2\,\overline{\xi^2}/\lambda_\infty^2$ (The proof is not given completely here). Also $\overline{\xi^2} = 5\,\overline{u^2}/\lambda^2$ ($\xi$ is the $x$-component of turbulent vorticity.) Hence $d\lambda^2/dt = 10\nu(\lambda^2/\lambda_\infty^2 - 1)$. If $\beta = \lambda^2/\lambda_\infty^2 - 1$, and is constant, then (with $x/U$ for $t$), $U/\sqrt{(\overline{u^2})} = \text{const.}\ (1 + \text{const.}\ x/U)^{1/2\beta}$. It is stated that there is a partial differential equation for $R(y)$ with $t$ and $y$ as independent variables, and this is illustrated here for the case of "one-dimensional" turbulence. If the shape of the correlation curve does not change with time, $R$ is a function of $y/\sqrt{(\nu t)}$, and it is in this case that $\beta$ is constant. S. G.

**2396. Flow in Pipes and between Parallel Planes. G. I. Taylor.** *Roy. Soc., Proc.* 159*A*. *pp.* 496–506, *April* 15, 1937.—The mean velocity is calculated for pressure flow between parallel planes and through a circular pipe on both the momentum-transfer and the vorticity-transfer theory with the mixing length proportional to the distance from a wall. The "modified" vorticity-transfer theory is used, in which a portion of the fluid is supposed to retain the vorticity components of the mean motion at a certain position until it mixes with its surroundings. Also the turbulence is assumed isotropic ($\overline{u^2} = \overline{v^2} = \overline{w^2}$). For two-dimensional mean motion the results are the same as for two-dimensional turbulence; for the pipe flow, however, the equation of motion is $-(1/\rho)\,\partial P/\partial x = (l^2 dU/dr)(d^2U/dr^2 + 1/r \cdot dU/dr)$. For pipe flow the vorticity-transfer theory is in better agreement with observation than the momentum-transfer theory. For flow between parallel planes there is nothing to choose between the two theories. The comparisons with experiment are carried out by making the velocity the same at the centre and at 0·7 of the distance from the centre to the wall, and the velocity gradient zero at the centre. (It is automatically infinite at the wall.) The constants in the formula for $l$ are much closer to each other for the two- and three- dimensional cases (on either theory) than with Kármán's formulæ for $l$ [see following Abstract], but in all cases the constants are different from the value obtained by considering the velocity distribution close to a wall. S. G.

**2397. Similarity Theory of Turbulence, and Flow between Parallel Planes and through Pipes. S. Goldstein.** *Roy. Soc., Proc.* 159*A*. *pp*. 473–496, *April* 15, 1937.—Kármán's similarity theory of turbulent flow for two-dimensional parallel mean flow leads to the result that the length $l$ which occurs $= K|dU/dy/d^2U/dy^2|$ and the shearing stress $\tau = \rho l^2 dU/dy|dU/dy|$. The derivation of the formulæ for three-dimensional turbulence is set out, with a full discussion of the order of magnitude of various terms. It is pointed out that if, instead of $\tau$, the rate (M) of communication of momentum to unit volume is taken from the theory, the equation of motion is the same as on the vorticity-transfer theory with $l$ as mixture length. The first form of the theory gives results which agree much better with experiment than the second for pressure flow between parallel planes. Formulæ for three-dimensional turbulence for parallel mean flow symmetrical about an axis are derived. (Consideration of the order of magnitude of the terms shews that the derivation is not as satisfactory as for the two-dimensional case.) The result is $l = K|dU/dr/(d^2U/dr^2 - 1/r \cdot dU/dr)|$, and again either $\tau$ or M may be found from the theory; in the former case the equation of motion is the same as on the momentum-transfer theory, in the latter as on the vorticity-transfer theory with symmetrical turbulence,—in each case with $l$ as mixing length. For pressure flow through a circular pipe the results obtained from the second form of the theory agree much better with experiment than the first. The comparisons with experiment in all cases are carried out by making the velocity gradient infinite at a wall, and by making the theoretical and experimental results for the velocity coincide at 0·3 and 0·7 of the distance from the centre to a wall. S. G.

**2398. Streaming of Liquids Through Small Capillaries. H. B. Bull and J. P. Wronski.** *J. Phys. Chem.* 41. *pp*. 463–468, *March*, 1937.—The viscosities of the first seven normal aliphatic alcohols are reported. The rate of flow of these alcohols and water is determined through diaphragms of cellulose, carbon, and glass, and in general the rate of flow per unit pressure through a given diaphragm appears to be a function both of the viscosity and of the degree of attraction between the liquid and the diaphragm. In loosely packed diaphragms there is a possibility of dispersion of the diaphragm material. Peptisation effects may be important in studies such as these. The average pore radii of the diaphragms is calculated and an estimate made of the critical radius below which anomalous rates of flow occur. AUTHORS.

**2399. Use of Elbow in Pipe Line for Determining Rate of Flow. W. M. Lansford.** *Univ. of Illinois, Eng. Exp. Sta., Bull. No.* 289. [33 *pp*.], *Dec.* 22, 1936.—Tests having been carried out for a number of different elbows (90° bends), the conclusion is reached that the ordinary commercial elbow may be successfully used as a flow meter. The difference between the pressure heads at the inside and outside of the middle (45°) section of the elbow is a constant multiple, $C_k$, of the mean velocity head of the water passing through the pipe for velocities greater than about 1·5 to 2·0 ft./sec. $C_k$ should be found by calibration in the actual set-up. If this is impossible, a value may be selected on the basis of the data given

which should give the discharge with an error not greater than 10%. 25 diameters of straight pipe preceding the elbow was found sufficient to ensure satisfactory performance, and it is stated that the discharge control valve should be at least 10 pipe diameters downstream from the elbow.
S. G.

*See also* Abstract 2492.

## KINETIC THEORY OF MATTER.

**2400. New Method for Measurement of the Bohr Magneton. O. Stern.** *Phys. Rev.* 51. *pp.* 852–854, *May* 15, 1937.—A molecular ray method for the measurement of forces acting on molecules is discussed in which these forces are compensated by the force of gravity (molecular balance).
AUTHOR.

*See also* Abstract 2803.

## MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

**2401. Infinite Integral Involving Bessel Functions and Parabolic Cylinder Functions. R. S. Varma.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 210–211, *April*, 1937.

**2402. Operational Forms for Bessel and Struve Functions. N. W. McLachlan and A. L. Meyers.** *Phil. Mag.* 23. *pp.* 918–925, *May*, 1937.—[See also Abstract 1949 (1937).]

**2403. Operational Representation of the Parabolic Cylinder Functions. R. S. Varma.** *Phil. Mag.* 23. *pp.* 926–928, *May*, 1937.—[See also Abstract 3478 (1936).]

**2404. Inverse Probability. S. R. Savur.** *Indian Acad. Sci., Proc.* 5A. *pp.* 222–234, *March*, 1937.—A new "statistical" solution is given in this paper of a problem in inverse probability called "The fundamental problem in practical statistics," by K. Pearson. This solution takes into account variation due to random sampling and is believed to be the most satisfactory solution to date. It is also believed that it will be possible now for the theory of inverse probability to be given its rightful place in the mathematical theory of probability.
AUTHOR.

**2405. "Closest" Estimates of Statistical Parameters. E. J. G. Pitman.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 212–222, *April*, 1937.—A definition of "closer" and "closest" as applied to estimates of statistical parameters is given, and it is shown that it can sometimes be proved that estimates properly derived from sufficient statistics are the closest possible. The scaling of a gamma distribution, and the location and scaling of an exponential distribution and of a rectangular distribution are discussed in detail, and the closest estimates of the parameters obtained.
AUTHOR.

**2406. Properties of Sufficiency and Statistical Tests. M. S. Bartlett.** *Roy. Soc., Proc.* 160A. *pp.* 268–282, *May* 18, 1937.—Properties of sufficiency must necessarily be considered for all small sample tests of significance, whether these are related to problems of estimation and fiducial distributions, or are of the nature of tests of goodness of fit. The idea of "conditional variation" is developed, and its bearing on common tests, depending either on continuous or discontinuous variation, is shown. In particular, the use of $\chi^2$ and other likelihood criteria is re-examined; and a new application of $\chi^2$ proposed for testing the homogeneity of a set of variances. AUTHOR.

**2407. Concepts of Dielectric Constant and Dimensions. A. G. Worthing.** *Am. Phys. Teacher*, 5. *pp.* 56–61, *April*, 1937.—Maintains the view that physical quantities are determined as to their natures by their complete dimensional formulae, and suggests criteria of consistency of physical concepts and equations, leading to the conclusion that the equations connecting electric displacement D, field strength E, and polarisation P should be written in the form $D = \epsilon E = kE/j = \epsilon_0 E + 4\pi P = E/j + 4\pi P$, where $\epsilon$ is the dielectric constant, $k$ specific inductive capacity, and $j$ is the constant of electrostatics analogous to the constant of gravitation. L. H.

**2408. Magnitudes and Units. A. Liénard.** *Soc. Franç. Élect., Bull.* 7. *pp.* 401–414, *April*, 1937.—The author discusses general aspects of physical magnitudes and units, leading to principles which should be borne in mind when considering the particular case of electrical and magnetic quantities and units. The distinction between measurable and relative quantities is pointed out, and stress is laid on the fact that the rules of arithmetic are not necessarily applicable to symbolic relations. In considering fundamental and derived units, the author illustrates a number of basic principles by reference to the fact that unit area might be taken as the area of a circle of unit radius, or of an equilaterial triangle of unit side. The altered form of familiar equations under such conventions is noted; also, the fact that unit area can be so defined that its dimension is not $L^2$ but $L$ or unity, as the case may be. Other geometrical examples demonstrate that comparisons between two magnitudes of different nature (as distinct from the ratio of their measures) have no meaning. The author goes on to discuss time and velocity relations, and the indications that may legitimately be drawn from formulae of dimensions. The theory of homogeneity is shown to have a more restricted field than is sometimes supposed. The number of fundamental units is essentially indeterminate. The number selected for a particular system of units is a matter of convenience and individual preference. Hence the interminability of discussions on units, and the expenditure of much time which might be better employed. R. E. N.

**2409. Consequences of the International Agreement for the Alteration of Electromagnetic Units. J. Fischer.** *Phys. Zeits.* 38. *pp.* 336–345, *May* 1, 1937.—The General Conference of Weights and Measures has decided to replace the international electric units hitherto used by units based on the absolute system. G. Mie pointed out many years ago that 4, and not 3 independent fundamental units are necessary for fixing the electromagnetic units. G. Giorgi proposed the ohm at present in use as the fourth unit. A more fundamental basis could be secured by assigning to the magnetic permeability of vacuum $\mu_0$ the particular value corresponding to the ohm at present in use. Resistances would still remain as at present, and the advantages of an "absolute" system would be secured. The International Commission has decided otherwise; as a result of its decision, the new ohm and the new volt will be about 5 parts in 10,000 smaller than the empirical units used at present, and all standards of resistance, inductance and capacity will need recalibration. In contrast with Mie's system, the ampere and volt will be derived from the fundamental mechanical units of length, mass and time. P. V.

***2410. Recent Apparatus for Mechanical Integration. W. Meyer zur Capellen.** *Zeits. f. Instrumentenk.* 57. *pp.* 103–117, *March, and pp.* 137–146, *April,* 1937.—A survey of new integrating apparatus described during the past year in periodicals, patent specifications, and catalogues. The underlying theory is set out in brief. A list of 64 references is given. P. H. B.

*See also* Abstracts 2370, 2389, 2411, 2516.

## MECHANICS, CLASSICAL.

**2411. Representation of Non-Linear Motions by Series of Damped Time Exponentials. R. A. Frazer.** *Phil. Mag.* 23. *pp.* 866–879, *May,* 1937.

*See also* Abstract 2492.

## MECHANICS, QUANTUM.

**2412. Foundations of the Statistical Transformation-Theory of Quantum Physics. M. Strauss.** *Preuss. Akad. Wiss. Berlin, Ber. Nos.* 24–27. *pp.* 382–398, 1936.—Using the methods and notation of mathematical logic, the author constructs the logical basis of quantum theory starting from the principle of indeterminacy and the idea of probability. G. C. McV.

**2413. Physical Content of Quantum Mechanics. W. V. Houston.** *Am. Phys. Teacher,* 5. *pp.* 49–55, *April,* 1937.—A summary of the quantum theory is given and it is contrasted with classical mechanics. The point of view is adopted that conjugate quantities are, by their definitions, mutually exclusive so that, for instance, a particle cannot be said to possess simultaneously both position and momentum. The principle of indeterminacy does not imply the breakdown of causal interaction between one part of a system and another. Such causal interaction is necessarily involved in the use of Schrödinger's equation. But the principle does apply to the interaction of a system with a measuring instrument, the causal development of the former being destroyed by the latter. G. C. McV.

**2414. Theory of Charged Elementary Particles. H. Hönl.** *Ann. d. Physik,* 28. 8. *pp.* 721–760, *April,* 1937.—An attempt is made to set up a wave equation of second order which should describe a proton and an electron, considering both as different states of the same particle. This is found to be impossible and a modified equation is then used in which proton and positive electron are described as states of the same particle. This would lead to the possibility of a proton and a negative electron annihilating with the emission of radiation. R. P.

**2415. Molecular Orbitals. A. F. Devonshire.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 250–252, *April,* 1937.—A method of obtaining an approximate solution of Schrödinger's equation with a non-central field of force is given for the case when a solution of a similar equation involving the angular coordinates only is known. AUTHOR.

**2416. Space Quantisation in a Gyrating Magnetic Field. I. I. Rabi.** *Phys. Rev.* 51. *pp.* 652–654, *April* 15, 1937.—The nonadiabatic transitions which a system with angular momentum $J$ makes in a magnetic field which is rotating about an axis inclined with respect to the field are calculated. It is shown that the effects depend on the sign of the magnetic moment of the system. We therefore have an absolute method for measuring the sign and magnitude of the moment of any system. Applications to the magnetic moment of the neutron, the rotational moment of molecules, and the nuclear moment of atoms with no extra-nuclear angular momentum are discussed. [See also Abstract 1494 (1936).] AUTHOR.

**2417. Helium Wave Equation. T. H. Gronwall.** *Phys. Rev.* 51. *pp.* 655–660, *April* 15, 1937.—This paper represents an attempt to solve the equation $\nabla^2\psi + (1/z)\psi_z + (1/4r)\ (E - V)\psi = 0$, which is the Gronwall form of the wave equation for He S states. The equation $\nabla^2 u + (1/z)u_z = 0$ is separable in polar coordinates $(r, \beta, \phi)$, and has solutions $u_{mk} = r^{2m-k} \sin^k \beta v_{mk}\ (\sin^2 \beta)\ e^{ik\phi} = r^{2m-k} w_{mk}\ (\beta, \phi)$, where the $v_{mk}$'s are Jacobi polynomials, and the $w_{mk}$'s form a complete orthogonal set of surface functions. The function $\psi$ is expanded as $\psi = \Sigma\psi_{mk}(r^{\frac{1}{2}})w_{mk}$, resulting in an infinite system of ordinary linear differential equations for the $\psi_{mk}$'s. [See following Abstract.] AUTHOR.

**2418. Helium Wave Equation. J. H. Bartlett, Jr.** *Phys. Rev.* 51. *pp.* 661–669, *April* 15, 1937.—This paper is a sequel to the preceding one by Gronwall [see preceding Abstract]. In Part I it is shown that the ground state eigenfunction, if it exists, cannot have the form $\psi = \sum_{p,\,k=0}^{\infty} s^{p+\gamma} a^{p,\,k}(\beta) \cos k\,\phi$, where $s = r^{\frac{1}{2}} = (r_1^2 + r_2^2)^{\frac{1}{2}}$, and $\gamma$ is some constant. In Part II, it is assumed that the solution of Gronwall's infinite system of ordinary differential equations is to be found by extrapolation from a finite system. Arguments are given to show that if the wave function is finite everywhere except at the origin, then the expansion about the origin is of the form $\psi = \sum_{k=0}^{\infty} c^{(k)}\ (s, \beta, \phi)\ (\log s)^k$, where the $c^{(k)}$'s are ascending power series in $s$. AUTHOR.

**2419. Wave Functions for the Normal Helium Atom. T. D. H. Baber and H. R. Hassé.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 253–259, *April*, 1937.—A comparison is made, as regards energy, magnetic susceptibility, and electric polarisability, of seven wave functions which have been suggested for the normal He atom. The functions considered include one, the calculation of which is given, developed as a simple extension of Hartree's wave function. Data for the polarisability of He and the positive Li ion and for the interaction of two He atoms at large distances apart are corrected and extended. N. M. B.

**2420. Mean Electric Density of a Complex Atom. G. Allard.** *Comptes Rendus,* 204. *pp.* 1057–1058, *April* 5, 1937.—In view of the satisfactory results obtained from the Slater-Pauling theory of directed valencies with the use of spherical functions, the possibility of finding some magnitude for a complex atom which might be rigorously represented by a linear combination of such functions is investigated. From the total electronic density, treated wave mechanically, a series of functions satisfying the required conditions is deduced. N. M. B.

**2421. Dirac Mechanics and the Final Jacobi Multiplier. R. Dugas.** *Comptes Rendus,* 204. *pp.* 1104–1106, *April* 12, 1937.—It has recently been shown [see Abstract 1962 (1937)] that the probability density in wave mechanics can be interpreted as a final Jacobi multiplier of a differential system in configuration space. It is now shown that in Dirac mechanics the probability density is similarly a final Jacobi multiplier of a system involving an expression which gives the velocity of the centre of gravity G of the probability, but, in absence of field, the point G oscillates by virtue of the Schrödinger vibration instead of undergoing uniform rectilineal motion. General considerations and conclusions are discussed. N. M. B.

**2422. Connection Formulæ and the Solutions of the Wave Equation. R. E. Langer.** *Phys. Rev.* 51. *pp.* 669–676, *April* 15, 1937.—A general discussion of asymptotic representations of the solutions of the one-dimensional wave equation is given. The forms used in the so-called W. K. B. method involve the Stokes' phenomenon in any region about a turning point at which the kinetic energy changes sign, and, in general, give no description of the solutions near the turning points. A method for representing the solutions of such differential equations by single valued functions, and the formulæ applicable to the wave equation and usable over the whole of an interval which includes a turning point are deduced. The Stokes' phenomenon is not involved unless expressions of the older type are desired, and then connection formulæ are evolved. Both the attractive and repulsive Coulomb field are considered with reference to the radial wave equation for motion in a central field of force. The application of the W. K. B. analysis to this equation as it has generally been made is uncritical and in error. Modification of the W. K. B. formulæ and correct application of the theory yield the formulæ indicated on other grounds. Finally the case in which a turning point lies too near the point $r = 0$ for the W. K. B. method to be effectively applicable is elucidated. N. M. B.

**2423. Complex Variables in Quantum Mechanics. P. A. M. Dirac.** *Roy. Soc., Proc.* 160 *A. pp.* 48–59, *May* 1, 1937.—The general representation theory of quantum mechanics requires the states of a dynamical system to be represented by functions of a set of real variables $q_r$, each of which has a domain consisting of either discrete points or a continuous range of points, or both together. A dynamical variable is represented by a function of two such sets of real variables $q_r'$ and $q_r''$ forming a generalised matrix. In this paper it is shown that in certain cases it is advantageous to consider some of the variables $q_r'$ as complex variables and to suppose the representatives of states and dynamical variables to depend on them in accordance with the theory of functions of a complex variable. In the usual theory the domains of the $q_r'$'s are the eigenvalues of certain observables $q_r$. This significance of the $q_r'$'s is lost when they are considered as complex variables but some mathematical features appear instead with a considerable gain of mathematical power. The treatment is put on a systematic basis and illustrated by a consideration of the H atom. N. M. B.

**2424. Quantum Theory of Atomic Polarisation. Parts I and II. R. A. Buckingham.** *Roy. Soc., Proc.* 160 *A. pp.* 94–126, *May* 1, 1937.—In Part I the theory of the polarisation of an atom by a uniform electric field is developed, using a variation method introduced by Kirkwood, and the atomic polarisabilities of several atoms containing closed electron groups calculated from their self-consistent fields. It is verified that an antisymmetrical wave function for the atom gives better results than a symmetrical function. Higher approximations, in which more parameters are introduced in the perturbed wave functions, are considered. Calculations with the Fock fields of the atoms of Be, $Na^+$, and $Cl^-$ show that the inclusion of exchange in the electron wave functions has considerable effect on the calculated polarisabilities. In Part II the method of Part I is extended to the polarisation of an atom by another distant atom and their mutual energy (the van der Waals energy) derived. The dipole-dipole constant is related to the atomic polarisabilities of the atoms, and the dipole-quadripole constant also expressed in a simple way in terms of observable quantities. Dipole-dipole constants are calculated for rare-gas atoms and for alkali ions in crystals, and the results compared with those obtained in other ways. The importance of the dipole-quadripole terms is discussed. AUTHOR.

**2425. Convergence of the Hylleraas Variational Method. A. S. Coolidge and H. M. James.** *Phys. Rev.* 51. *pp.* 855–859, *May* 15, 1937.—The result of Bartlett, Gibbons and Dunn [see Abstract 2407 (1935)] that the wave function for He cannot be expressed as a power series in the particle separations $r_1, r_2, r_{12}$, is discussed in relation to the validity of the Hylleraas variational attack. By a simple analogous example, it is shown that this result does not establish the impossibility of using polynomials in these variables to represent the function as closely as desired. It is further shown that if a formal solution of the wave equation for He exists, then the energy given by the Hylleraas method will converge upon the correct energy and the function will converge in the mean upon the correct function. Even if there exists no formal solution of the wave equation, there is a lower bound to the energy which can be computed with any function, and upon this bound the Hylleraas method will converge. In either case, therefore, the method is justified. AUTHORS.

**2426. Criteria of Goodness for Approximate Wave Functions. H. M. James and A. S. Coolidge.** *Phys. Rev.* 51. *pp.* 860–863, *May* 15, 1937.—The relations between the root-mean-square error of an approximate ground state wave function, the energy error, and the root-mean-square local energy deviation are exhibited and discussed. Computations of these quantities for helium wave functions containing errors of different character and magnitude are presented, and are shown to indicate that the errors in wave functions of the Hylleraas type are of increasingly short range character as these functions are made more flexible. The form of variational process which will give a wave function most satisfactory for a given purpose is discussed with illustrative computations relating to the diamagnetic susceptibility of He. It is found that the energy error associated with a wave function may be a comparatively unsatisfactory criterion of goodness. AUTHORS.

**2427. Density of Eigenfunctions for an Electron Obeying Dirac's Equation. E. K. Broch.** *Phys. Rev.* 51. *pp.* 586–588, *April* 1, 1937.—In the theory of an ideal gas it is shown that enclosing the electrons in a spherical potential boundary leads to the same results as imposing periodicity conditions on the wave function. The calculation shows that it is immaterial, for this type of enclosure, whether "standing" or "progressive" waves are used. G. C. McV.

*See also* Abstracts 2290, 2613, 2647, 2648, 2811, 2812.

## RELATIVITY AND ETHER.

**2428. Diurnal Variation in the Earth's Lorentz Contraction. L. Courvoisier.** *Zeits. f. Physik*, 105. 1–2. *pp.* 122–126, 1937.—The author's rotatable level apparatus [see Abstract 4550 (1936)] was again used in Oct.–Nov. 1936 to investigate the postulated Lorentz contraction of the earth due to its motion through space. The experiments supplement those made in the spring of 1936, corrections being applied to allow for the different orbital motions of the earth. The observations now available extend over a whole sidereal day; the variation during that time is shown graphically.

The values confirm the theoretical assumptions reasonably well. It is therefore affirmed that the earth suffers a Lorentz contraction due to its " absolute " translation through space at 393 ± 23 km./sec. towards the point R.A. 77° ± 3° ; dec. + 45° ± 7°. A. Hu.

**2429. Expansion in Powers of the Gravitational Constant in General Relativity. J. L. Synge.** *Roy. Soc., Proc.* 160*A*. *pp.* 187–189, *May* 18, 1937.—In a recent paper [see Abstract 2027 (1936)] Temple has employed a method based on the expansion of tensors in space time in powers of the gravitational constant. The assumption that the coefficients in such power series are themselves tensors forms the basis of his definition of teleparallelism and of his form of Gauss's theorem. It is shown in the present note that the coefficients in question do not possess tensor character, a fact which invalidates Temple's results. The absence of tensor character is due to the fact that there is under consideration, not one universe, but a set of universes, and hence we must take into consideration transformations of coordinates which involve the gravitational constant. AUTHOR.

**2430. Choice of the Action Function in the New Field Theory. B. Hoffmann and L. Infeld.** *Phys. Rev.* 51. *pp.* 765–773, *May* 1, 1937.—By the imposition of a regularity condition on the new field theory a new action function is found which is unique so far as the significant lower order terms of its expansion are concerned. The new action function leads to a theory in which the $f_{kl}$ field is free from singularities, from which magnetic poles are automatically excluded, and in which the equations of motion can be deduced from the field equations without extra dynamical assumptions. When general relativity is taken into account the field of a particle is such that space-time is everywhere regular, and the theory leads to the identification of gravitational with electromagnetic mass. AUTHORS.

**2431. Notion of Time. E. Esclangon.** *Bull. Astronomique*, 10. 1. *pp.* 1–72, 1937.—Starting from the point of view that clocks at different places may go at arbitrarily different rates, the author emphasises the conventionality of the measurement of time. A set of clocks, calibrated by means of light signals, together with the principle that there is no absolute velocity in the universe, leads to the Lorentz transformation and to special relativity. The author also studies different types of accelerated motion which are invariant under Lorentz transformations and concludes that, in a sense, the equations of dynamics are deducible theoretically and without an appeal to " laws of motion." The theory has some points of resemblance with Milne's " kinematical relativity." G. C. McV.

**2432. Photometric Consequences of the Einstein Gravitational Deflection. F. Link.** *Bull. Astronomique*, 10. 1. *pp.* 73–90, 1937.—It is pointed out that the Einstein deflection of light rays in a gravitational field should modify the illumination produced by the rays. The modification in the cross-sectional area of an elemental cone of radiation from a point source is expressed as a function of the distance at which it passes the deflecting body. The treatment is then extended by integration to include the case of occultation of one star by another. Variations in the geometrical form of a star so occulted, as see from the earth, are shown diagrammatically. Except in certain circumstances where interferometric methods might yield results, however, such variations of form are beyond detection by present observational means. Changes in the total brightness during occultation, however, may in favourable circumstances yield observable results. It is suggested that the abnormal brightness increase near the centre of globular clusters—an increase beyond that explicable by a mere increase in the number of component stars—may be due to this photometric Einstein effect. A. Hu.

## SOLUTION.

**2433. Salting-Out of Gases and Volatile Non-Electrolytes. J. W. Belton.** *Faraday Soc., Trans.* 33. *pp.* 653–659, *May*, 1937.—The activity coefficient of a non-electrolyte is derived from considerations of the equilibrium between the liquid and the vapour phases, and is shown to be given by $e^{E/RT}$, where E is the electrical work involved in the passage of ions from one phase to the other. This work is calculated from the change in polarisability of the non-electrolyte molecule and the equation of Debye and McAulay is obtained. A more complex expression for the activity coefficient is derived including the permanent moment of the non-electrolyte molecule and its application to cases for which experimental data are available is discussed. It is also shown that the salting-out equation of Debye and Gross may be obtained from similar considerations. AUTHOR.

**2434. Ion Equilibrium in Heavy Water. C. Drucker.** *Faraday Soc., Trans.* 33. *pp.* 660–670, *May*, 1937.—The solution tension of $D_2$ is established, by measurements, to be equal to the solution tension of $H_2$ and evidence is given that in liquid mixtures of $D_2O$ and $H_2O$ equilibrium is always in existence. The ionic activities in $D_2O$ and in mixtures of $D_2O$ and $H_2O$ are measured electrometrically, and it is shown that they can be calculated from the composition of the solvent. The concentrations of the four ions $H^{\cdot}$, $D^{\cdot}$, $OH'$ and $OD'$ in pure water are calculated and a connection with reaction velocity is discussed. AUTHOR.

**2435. Solubility of Indium in Mercury. W. G. Parks and W. G. Moran.** J. *Phys. Chem.* 41. *pp.* 343–349, *March*, 1937.—Indium amalgams were prepared by the direct addition of a weighed quantity of the metal to a weighed quantity of Hg. The solubility of In in Hg is reported at 0°, 12·5°, 25°, 37·5°, and 50° C. In the temperature range from 0° to 50° C. the solubility is represented by the equation $\log N_2 = (53\cdot 57/T) + 1\cdot 714$, where $N_2$ is the weight fraction of In in the saturated amalgam. The difficulties involved in the determination of a homogeneous phase by filtration are pointed out. The solubility of In in Hg indicates that In has a rather high internal pressure, approximately the same as that of Pb. From the general behaviour of In amalgam it is believed to be suited for precise e.m.f. measurements. AUTHORS.

**2436. Solubility of Hydrogen in Metals. R. H. Fowler and C. J. Smithells.** *Roy. Soc., Proc.* 160 *A. pp.* 37–47, *May* 1, 1937.—The case of metals such as Cu, in which the H appears to be dissolved as free protons and the normal metal lattice is almost unaffected, is examined. Through a function for the partition, inside and outside the metal, of H as atoms and molecules an expression for solubility for Cu and for the Fe group is deduced which finally reduces to $\log s < 5\cdot 89 - (\chi_s + \frac{1}{2}\chi_d)/kT$ where $\chi_s$ represents the excess energy of the H atom at rest or in its lowest quantum state in the metal above its energy similarly outside, and $\chi_d$ is the dissociation energy of the $H_2$ molecule. The partition function is checked by considering the absorbed H as protons + electrons. General results are shown to be in agreement with observations for N, Fe, Co, and Cu. A tentative theory for the case of hydride formation is given and is discussed in relation to observations for Ti, V, Zr, and Th. N. M. B.

**2437. Solubility Product of Thallous Iodide at 25°. C. W. Davies and R. A. Robinson.** *Faraday Soc., Trans.* 33. *pp.* 633–635, *May,* 1937.—The application of conductimetric titrations to the determination of a solubility product is described, and the solubility product of thallous iodide at 25° is found to be $6{\cdot}47 \times 10^{-8}$. AUTHORS.

*See also* Abstracts 2358, 2364, 2441, 2729.

## SURFACE TENSION AND COHESION.

**2438. Surface Tension Theory. K. Ariyama.** *Chem. Soc., Japan, Proc.* 12. *pp.* 109–116, *March,* 1937. *In English.*—The Debye-Hückel theory cannot serve as a basis for the explanation of the decrease of surface tension of solutions of inorganic acids with increasing concentration. The effect is explained quantitatively by the postulation of an orientation of water molecules at the surface different from that in the interior, together with the semi-empirical structure of water suggested by Bernal and Fowler [see Abstract 3951 (1933)]. Additional support for this theory is obtained from Belton's results [see Abstract 105 (1936)], for the surface tensions of ternary solutions of inorganic salts and inorganic acids. P. H. B.

**2439. Interfacial Tensions of Mercury-Hydrocarbon Oil Systems. J. L. Culbertson and F. A. Hedman.** *J. Phys. Chem.* 41. *pp.* 485–493, *March,* 1937.—Measurements of the Hg-oil interfacial tension are made on six different systems, to wit, four Hg-lubricating oil and two Hg-refined white oil systems. Measurements are made at 25° intervals from 25° C. to 125° C. The refined white oils with the Hg show an approximately linear relation between the interfacial tension and the temperature. On the other hand the motor oils show, for this relation, data which seem to indicate a characteristic interaction between such oils and the mercury surface. AUTHORS.

**2440. Effect of Radiation on Oil Drops. W. Stenstrom and I. Vigness.** *J. Chem. Phys.* 5. *pp.* 298–301, *May,* 1937.—Oil drops on a water surface increase their diameter when they are irradiated with $\beta$-rays, X-rays, or u.v. rays. The growth of the diameter depends on the amount of exposure to the radiation. Curves showing the increase of diameter with time have been made. If oil in a closed container is irradiated with X-rays, and drops from such irradiated oil are placed on a water surface, the drops spread and reach a limiting size after a few hours. The experiments made are of a preliminary nature and are intended to demonstrate the general nature of the phenomena. AUTHORS.

**2441. Soaking of Coloured Liquids into Porous Bodies. A. Boutaric.** *Ann. Soc. Sci. de Bruxelles,* 57. *pp.* 39–52, *March* 16, 1937.—When filter paper dips in a coloured liquid the rate of rise of the solvent by soaking into the paper is often unaffected by the presence of the colouring matter, which often ascends more slowly. The rise of the coloured ions or colloidal particles is due to entrainment with the rising solvent. Surface tension does not play any considerable part, while electrical phenomena have little effect except in the actual attachment of the particles to the porous body by adsorption. The use of the term "electrocapillary analysis" in connection with the phenomenon dealt with is deplored. P. H. B.

*See also* Abstracts 2279, 2287, 2288.

## TIME (STANDARDS, MEASUREMENTS, APPARATUS).

***2442. Wrist-Watches in Use.** **W. Keil and K. Hild.** *Phys. Zeits.* 38. *pp.* 309–318, *May* 1, 1937.—A report on the performance of four types of 10½ line, 15 jewel wrist-watches with uncut balance wheels. Both the mean rate and fluctuations in the rate were found to depend more on temperature and on the quality and the adjustment of the movement, than on external factors such as vibration. The performance of a wrist-watch seldom remains uniform for an extended period, but changes slowly, mainly owing to changes in the lubricating oil. P. H. B.

*See also* Abstract 2431.

## VACUA, HIGH.

**2443. Thermionic Control of an Ionisation Gauge.** **L. N. Ridenour and C. W. Lampson.** *Rev. Sci. Instruments,* 8. *pp.* 162–164, *May,* 1937.—An improved method of controlling the grid current of an ionisation gauge is described. The principle employed is applicable to control of current or voltage in a variety of low power circuits. AUTHORS.

## VISCOSITY, FRICTION AND LUBRICATION.

**2444. Viscosity of Liquid Selenium.** **S. Dobiński and J. Wesolowski.** *Acad. Polonaise Sci. et Lettres, Bull.* 1–2*A*. *pp.* 7–14, *Jan.–Feb.,* 1937. *In English.*—The viscosity of liquid Se is measured between 215·7° and 345·8° C. The viscosity does not show any singularities similar to those observed by Pelabon in the electric conductivity. The data obtained show that the molecules in liquid Se are associated. AUTHORS.

**2445. Influence of Electric Field on Viscosity of Pure Liquids and Colloidal Solutions.** **Y. Björnstahl and K. O. Snellman.** *Kolloid Zeits.* 78. *pp.* 258–272, *March,* 1937.—Conducting and non-conducting liquids have been examined and for several a decided effect has been found. The effect has been considered with reference to several theories and even for dilute solutions of electrolytes it has been concluded that the gas theory of Maxwell is an insufficient explanation. The nature of the effect in a dielectric medium is very complicated. [See Abstract 4128 (1935)]. J. K.

**2446. Viscosity and Rigidity of Glucose Glass.** **G. S. Parks and J. D. Reagh.** *J. Chem. Phys.* 5. *pp.* 364–367, *May,* 1937.—By an electromagnetic torsion method, in which glucose glass threads were substituted for the phosphor-bronze suspension in a d'Arsonval galvanometer, the rigidity and viscosity of glucose glass have been measured between 12° and 37·5° C. The rigidity values were fairly constant around 2·5 ($10^{10}$)dynes per cm$^2$. between 12° and 30° but decreased rapidly above the latter temperature. The viscosity values ranged between $10^{15}$ and $10^{10}$ poises. These values decreased rapidly with rising temperatures but also depended greatly on the previous history of the glass threads, *i.e.*, the extent to which the threads had been annealed and the amount of previous working to which they had been subjected. This finding suggests the existence of a series of glassy states for a substance such as amorphous glucose. AUTHORS.

**2447. Viscosities of Liquid Mixtures with Pyrrole as a Component. M. Dezelic.** *Faraday Soc., Trans.* 33. *pp.* 713–719, *May*, 1937.—The viscosity and specific gravity of binary systems containing pyrrole with piperidine, pyridine, nicotine, quinoline, diethylamine, chloroform, glacial acetic acid, *n*-butyric acid, allyl *iso*thiocyanate and nitrobenzene, respectively, are investigated. The first five substances, of a basic character, form complexes of molecular compounds with pyrrole. The viscosity curve of the first three of these systems is characterised by a maximum and that of the following two by a convexity. All five showed a rise in temperature during the mixing of the components. The last five systems have concave viscosity curves, and do not evolve heat on admixture of the components. In these systems the components apparently form no complexes or compounds in the liquid phase. These results afford proof of the fact that the acid characteristics of unsubstituted pyrrole are much stronger than the basic ones. This accords with the results of the investigation of the Raman-spectra of pyrrole, according to which pyrrole would have "acid" properties, as compared with substituted pyrroles. AUTHOR.

**2448. Viscosity of Air. W. N. Bond.** *Phys. Soc., Proc.* 49. *pp.* 205–213, *May* 1, 1937.—The viscosity of dry air at atmospheric pressure was measured by a capillary-tube method, at about 15° C. The ends of a wide-limbed U tube containing paraffin oil, of density 0·87, were connected by a pair of capillary tubes in series, so as to form a closed system. The oil was initially displaced, and in proceeding towards its equilibrium position it forced air through the capillaries. Care was taken to avoid constant and systematic errors, and two U tubes, two sets of capillaries and two methods of drying the air were used. Assuming that the viscosity increases by $4{\cdot}93 \times 10^{-7}$ per °C., the value at 23° C. is $(1834{\cdot}7 \pm 0{\cdot}8) \times 10^{-7}$ c.g.s. units. The paper includes a summary of the general theory of the capillary-tube method and the correction terms involved, as well as a detailed theory of the present experiments. AUTHOR.

**2449. Dependence of Viscosity and Density of Fats and Fatty Acids on Iodine Number. G. B. Rawitsch.** *Acta Physicochimica*, 6. 2. *pp.* 205–212, 1937. *In German.*—The viscosities of stearic, oleic and linolenic acids (iodine numbers 0, 90 and 270 respectively) over the range 20°–90° C. show a linear decline of viscosity with increasing iodine number, the isotherms intersecting at a common point. The densities of the same compounds increase with increasing unsaturation. Measurements of viscosity and density at intervals during the hydrogenation of a mixture of cotton seed and linseed oils also show a regular change in these properties with iodine number. Hence viscosity measurements, in particular, can be used to determine the course of such reactions. L. V. C.

**2450. Oiliness of Liquids. Part III. Kinetic Friction Coefficients. J. Sameshima and M. Miyake.** *Chem. Soc., Japan, Bull.* 12. *pp.* 96–103, *Feb.*, 1937.—Direct measurements were made of the frictional force on a loaded horizontal steel plate resting tangentially on a horizontal steel roller, which rotated uniformly while dipping in the liquid under test. The computed kinetic friction coefficients, $\mu_k$, were constant over a wide range of load conditions, except in the case of water for which results were variable. For *n*-aliphatic alcohols, $\mu_k$ declines linearly with increasing chain-length (up to $C_8$); for *n*-aliphatic acids the same is seen from $C_3$ to $C_9$; but *n*-aliphatic hydrocarbons ($C_6$ to $C_9$) show a minimum $\mu_k$ at $C_7$. [See following Abstract.] L. V. C.

**2451. Oiliness of Liquids. Part IV. Static Friction Coefficients by the Method of Inclination. J. Sameshima and Y. Tsubuku.** *Chem. Soc., Japan, Bull.* 12. *pp.* 127–132, *March,* 1937. *In English.*—The measurements of the static friction coefficients by the balance method have already been described [see Abstract 548 (1937)]. The method of inclination and the results obtained therefrom are now considered. The method is based on the measurement of the critical angle of inclination of the sliding surface at which the slider begins to slide. Full experimental details are given. It is shown that the frictional coefficients of aliphatic acids are nearly constant, while those of aliphatic alcohols diminish with the number of carbon atoms in their molecular formula. The lengths and the diameters of the molecule of octyl alcohol and nonylic acid are found to be 4·6, 12·1, 4·5 and 14·1 Å respectively, so that owing to their comparative shortness these molecules will not bend by the pulling forces. [See preceding Abstract.] H. H. Ho.

**2452. Heat Effects in Capillary Flow at High Rates of Shear. M. D. Hersey and J. C. Zimmer.** *J. of Applied Physics,* 8. *pp.* 359–363, *May,* 1937.—This paper describes a theoretical and experimental study of heat effects in viscous liquids up to rates of shear of the order of a million reciprocal seconds, corresponding to the rates experienced in lubrication practice. Even at much lower rates the effect of heat generated by viscous resistance in a capillary tube is sufficient to produce an appreciable drop in the apparent viscosity. This drop cannot be fully corrected for by laboratory observations of the mean efflux temperature, since the temperature-rise will not be uniform over the cross-section. Detailed calculations are necessary in order to distinguish between heat effects and non-Newtonian behaviour. The theory is illustrated by experimental data on lubricating oils. AUTHORS.

**2453. Effects of Pressure and Temperature on the Viscosity of Lubricating Oils. R. B. Dow.** *J. of Applied Physics,* 8. *pp.* 367–372, *May,* 1937.—The viscosities of three lubricating oils are investigated at 100°, 130°, 210·2° F. at pressures ranging from 1 to 4000 atmos. (57,000 $\text{lb./in}^2$.). While the oils were from fields widely separated geographically, their initial viscosities were matched at 0·4 poise at 130° F. At a pressure of 26,000 $\text{lb./in}^2$. at 130°, however, the viscosities were strikingly different; the viscosity of the Pennsylvania oil increased 25-fold, and the Oklahoma oil 35-fold, but for the California sample the increase of viscosity was greater than 100-fold. The effect of pressure on the temperature coefficient of viscosity and the effect of temperature on the pressure coefficient of viscosity are discussed. AUTHOR.

***2454. Capillary Viscometers. W. Philippoff.** *A.T.M. No.* 69. *T*34–*T*35, *March,* 1937.—Capillary viscometers are classified as absolute or standard [see Abstract 4046 (1936)], relative [*e.g.*, Ostwald, Ubbelohde (with and without "suspended level"), Vogel-Ossag] and conventional [Engler, Ford and Rankine (for gases)]. The various types are illustrated, in most cases with dimensions, and the treatment is authoritative, with full Bibliography. L. V. C.

*See also* **Abstracts 2304, 2375, 2376, 2377, 2378, 2382, 2398, 2439, 2545, 2723, 2771.**

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# ASTRONOMY AND ASTROPHYSICS.

## ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT

*See* Abstract 2475.

## COMETS AND METEORS.

**2455. Motion of Comet Wolf I. M. Kamieński.** *Acad. Polonaise Sci. et Lettres, Bull.* 1–2*A. pp.* 23–59, *Jan–Feb.,* 1937. *In French.*—An investigation of the exact values of perturbations by Venus, Earth, Mars, Jupiter, Saturn and Uranus (those by Mercury and Neptune being insignificant), on the Wolf I orbit for 1925–1934, this last date completing the first 50 series of observations since discovery in 1884. The chief method of computation is by the variation of arbitrary constants; the elements being changed at the end of each interval which varied from $\lambda = 1^d\ 25$ to $\lambda = 40^d$, according to the mass of the planet in question and its distance from the comet. Other methods can be used [see Abstracts 1083 and 3519 (1936)]. The present memoir contains in its tables the definitive values of the perturbations and the resultant systems of elements; also the numerical values of the differentials of these perturbations, which are already free from the influence of superior orders. A. S. D. M.

**2456. Meteorites and the Craters on the Moon. L. J. Spencer.** *Nature,* 139. *pp.* 655–657, *April* 17, 1937.—The chief arguments against the meteoritic origin of the lunar craters are (1) that they are all circular and meteorites would come from various directions, and (2) there are very few such craters on the earth. As regards (1) the craters are the results of explosion due to conversion of kinetic energy of motion into heat and so independent of direction. As for (2) 95 % of recorded terrestrial falls are of stones, whereas all terrestrial meteoritic craters are due to irons, which also form 82 % of terrestrial finds of which the fall was not observed. But passage through the earth's atmosphere would destroy stones much more completely than irons and subsequent denudation would rapidly remove all traces that reach the earth, as also their craters; whereas on the moon with no atmosphere there would be little difference in these respects between irons and stones. The rays around some lunar craters are probable particles of metallic iron vaporised and shot out on impact, the proportion of craters showing these being approximately the same as recorded falls of irons to falls of stones on the earth. C. A. S.

## COSMOGONY.

**2457. Cosmological Constants. S. Chandrasekhar.** *Nature,* 139, *pp.* 757–758, *May* 1, 1937.—The author directs attention to a combination of certain "natural" constants (the velocity of light, the mass of the proton, the constant of gravitation and Planck's constant, $h$) which has the dimension of mass. A particular form of this combination occurs in the theory of stellar interiors. By substituting simple values for the arbitrary constant in the formula, the author shows that one can obtain numbers comparable with the mass of the Milky Way, and with the total number of protons and/or neutrons in the universe—such as were derived by Dirac from similar dimensional arguments [see Abstract 1558 (1937)].

*See also* Abstracts 2384, 2584.

## DYNAMICAL PROBLEMS (ASTRONOMICAL).

**2458. Derivation of Gibbs' Formulæ. K. Koziel.** *Acad. Polonaise Sci. et Lettres, Bull.* 10*A*. *pp.* 536–559, *Dec.*, 1936. *In German.*—The Gibbs triangle-ratio formulæ used in the calculation of the orbits of celestial bodies are derived by approximating with polynomials of the 4th degree in the time, and using the differential equations obtained by Banachiewicz. Ebert's formulæ are shown to be derivable as special cases from those of Gibbs. The accuracy of these approximations is fully investigated and illustrated by means of numerical examples. Other known formulæ are derived by using approximation polynomials of various degrees, and their accuracy is compared with that of new and more precise formulæ developed by the author. A. Hu.

**2459. Stellar Problem of Three Bodies. Part IV. E. W. Brown.** *Roy. Astron. Soc., M.N.* 97. *pp.* 388–395, *March*, 1937.—The author applies his treatment [see Abstract 1088 (1937)] of this problem to the system of $\xi$ Ursæ Majories, which consists of two pairs of stars, the distances between the components of each pair being small compared with the distance apart of the pairs. The perturbing effect of the closer pair, treated as a single body of mass equal to the sum of the masses of its components, on the relative motion of the components of the other pair is worked out. The apparent eccentricity of the orbit is found to vary from 0·18 to 0·54 and the inclination from 37° to 47°. The principal long-period terms in the elements have a period of 30 years, with coefficients of the order of 1°. G. C. McV.

## NEBULÆ.

**2460. Surface Brightnesses of Diffuse Galactic Nebulæ. O. Struve.** *Astrophys. J.* 85. *pp.* 194–212, *April*, 1937.—The author investigates a theory of diffuse scattering in nebulæ [see Abstracts 1530 and 4574 (1936) and 1980 (1937)]. Rayleigh scattering contributes little but certain nebulæ show selective reddening for transmitted light indicating some small particles. Dark nebulæ may contain cores and the colour of their luminous edges is yellow; it is that of the night sky background, similar to integrated starlight. The Lambert phase function is examined but rejected; he takes the Lommel-Seeliger theory of diffuse reflection, and computes the surface brightness making three assumptions for nebulæ uniformly, illuminated by starlight, and gives a table of the ratio, edge to centre, and curves. The observations favour a fairly large value of the spherical albedo, $\gamma$, and a phase function which throws most of the scattered light in the direction of the incident beam. Not all the nebulæ have dark cores; where a lane shows none, it is inclined to the plane perpendicular to the line of sight. A definite phase effect is suggested by bright rims surrounding dark nebular material, as in the horse-head nebulæ, B33. A list is given of these rims; they are nearly all of emission type; his explanation is confirmed by Zanstra's theory of nebular radiation. A. S. D. M.

**2461. Supplementary Star-Counts in the Dark Nebula in Taurus. H. v. Klüber.** *Zeits. f. Astrophysik*, 13. 3. *pp.* 174–178, 1937.

—In continuation of a previous paper [see Abstract 3403 (1933)] further results of counting in the dark nebula of Taurus are communicated. Reflector photographs of a region, presumed to be one of strongest absorption, are obtained which permit counting up to the magnitude 17. It is found that the absorption increases continuously up to magnitude 17 and there already amounts to 4 magnitudes. J. E. K.

**2462. Accuracy of Magnitudes of External Galaxies. C. K. Seyfert.** *Harvard Coll. Obs., Bull. No.* 905. *pp.* 19–22, *March* 1, 1937.—A comparison of total photographic magnitudes of faint galaxies, determined at Harvard from in-focus plates, with the magnitudes determined by Baade and Keenan, reveals no detectable systematic error in the Harvard values. The comparison indicates a mean error of $\pm 0^{\mathrm{m}}\cdot 19$ for a single magnitude obtained from one plate taken with the Harvard 16-in. Metcalf doublet, and $\pm 0^{\mathrm{m}}\cdot 17$ for a magnitude determined from one plate taken with the 3-in. Ross camera. [See following Abstract]. AUTHOR.

**2463. Extra-Galactic Nebulæ. Part II. Comparison of Yerkes and Harvard Magnitudes. P. C. Keenan.** *Astrophys. J.* 85. *pp.* 325–329, *May*, 1937.—Total photographic magnitudes of 120 nebulæ are tabulated. From 51 objects common to the two lists the correction to the magnitudes of the Shapley-Ames catalogue is found to have the constant amount − 0·08 mag. between the 11th and 13th magnitudes. The mean error of the individual Harvard magnitudes is estimated as ± 0·20 mag. [See preceding Abstract]. [For Part I see Abstract 3347 (1935)]. AUTHOR.

*See also* Abstract 2593.

## PLANETS.

**2464. Mean Motions of the Lunar Perigee and Node and the Figure of the Moon. H. Spencer Jones.** *Roy. Astron. Soc., M.N.* 97. *pp.* 406–409, *March*, 1937.—E. W. Brown's corrections [see Abstract 1088 (1937)] to the centennial motion of the lunar perigee and node are applied in a revision of the calculations giving the figure of the moon. The quantity $f$ found by calculation is now in agreement with the value deduced from libration observations. The ellipticity of the earth is found to be 1/(296·08 ± 0·95). G. C. McV.

*See also* Abstract 2456.

## STARS.

**2465. Observations of B-Type Stars in the Red and Infra-Red Regions of the Spectrum. J. S. Hall.** *Astrophys. J.* 85. *pp.* 145–155, *April*, 1937.—The difference in magnitude between $\zeta$ and $\epsilon$ Persei has been determined throughout a spectral region of more than 5000 Å with a photoelectric photometer used in conjunction with an objective grating. When these observations are combined with those by Kienle and by Rudnick, the difference in magnitude between these two stars is, to a first approximation proportional to the frequency. These data therefore do not definitely disprove the hypothesis that the peculiar colour of $\zeta$ is either partly or entirely due to a temperature difference between these two stars. If this colouring is attributed to matter in interstellar space, the wave-length exponent in the attenuation term is near unity in the observed spectral region. A more literal interpretation of the data suggests that this exponent increases from about 1·2 in the visual to 1·6 in the infra-red. Infra-red colours and magnitudes of 19 B stars have been determined. A comparison of the colour excesses computed from these data with those given by Stebbins and Huffer also indicates that this exponent is near unity. [See also Abstract 990 (1934)]. AUTHOR.

**2466. Spectra of Class Be. D. B. McLaughlin.** *Astrophys. J.* 85. *pp.* 181–193, *April*, 1937.—Observations of the relative intensities of components of double emission lines (V/R) and of the emission intensities relative to the continuous spectrum (E/C) are given for a number of the brighter Be stars, bringing a previous survey (1932) up to date. During the 25 years of the Ann Arbor program, three stars previously constant in V/R have begun to vary, and three others, formerly conspicuously variable, have become constant. It is suggested that these represent different stages of the history of any V/R variable, and that periods of variation alternate with periods of constancy in most, if not all, Be spectra. The period of recurrence of variability is probably a century or more. AUTHOR.

**2467. Colour Indices Observed with the Loomis Telescope. A. L. Bennett.** *Astrophys. J.* 85. *pp.* 257–278, *May*, 1937.—Colour indices of 254 relatively faint stars of all spectral types in the zone +25° to + 30° were observed in the red and infra-red with the photoelectric photometer employing the Cs-O-Ag cell. The effective wave-lengths of the spectral regions used were approximately 6900 and 8800 Å, giving a scale of indices of 0·74 mag. for the interval Ao-Ko. No definite dependence of the colour indices on H $(= m + 5 + 5 \log \mu)$ or on galactic latitude was found. The abnormal B3 and B5 stars observed in the blue by Stebbins and Huffer have infra-red excesses too large to be accounted for by Rayleigh scattering. The relation between the indices of the bright stars observed by Hall at Yale and of these faint stars is derived by means of stars reobserved for the purpose. This equation is then used to compare the mean indices, for the various spectral types, of the bright stars observed by Hall with those of the relatively faint stars of this paper. AUTHOR.

**2468. Variable Spectrum of δ Cephei. C. J. Krieger.** *Astrophys. J.* 85. *pp.* 304–324, *May*, 1937.—The equivalent breadths of 355 lines are measured on microphotometer tracings of 20 one- and three-prism spectrograms and are listed in a catalogue. The variation of the equivalent breadths of the lines of H, Ca, Ti, Cr, Mn, Fe and Sr, of the lines λλ 4129, 4205, 4256, and 4280, and of the band at λ 4200 and λ 4300 is studied in detail throughout the entire period. From the ratio of K(Ca II) to Hδ a variation in spectral type from F5 just before maximum light to G4 near minimum is found. Five luminosity criteria, 4071/4077, 4161/4167, 4125/4250, 4233/4235, and 4246/4250, indicate an average absolute magnitude $M = -2$. The application of Adams and Russell's method to the lines of Ca, Ti, and Fe leads to a variation of the photospheric temperature from 6600° K at maximum light to 5200° K near phase 3·5 days, and to a variation of the logarithm of the effective electron pressure from − 5·2 near maximum light to − 6·7 near phase 3·5 days. Comparisons with other determinations are made. The variation of the relative abundance of Ca I, Ca II, Ti I, Ti II, Cr I, Mn I, Fe I, Fe II, and Sr II throughout the entire period is determined. An increase of the amount of metallic vapour above the photosphere near minimum light to about five times the value at maximum light is found. [See also Abstract 103 (1934).] AUTHOR.

**2469. Photoelectric Light Curve of Algol. W. M. Smart.** *Roy. Astron. Soc., M.N.* 97. *pp.* 396–406, *March*, 1937.—The details are given of photometric observations of this star made at Cambridge since 1932. The mean period of light fluctuation found is (in days) 2·86731 ± 0·000004. The observations also yield values for the variations in the period of the light-curve. G. C. McV.

**2470. Physical Interpretation of the Light-Curve of Nova Herculis 1934. W. Grotrian.** *Zeits. f. Astrophysik*, 13. 3. *pp.* 215–240, 1937.—The march of the luminosity of this variable indicates that from maximum to the end of March, 1935, there was an outflowing photospheric zone of matter surrounded by an expanding gaseous shell in which absorption and emission took place. The photospheric zone suddenly ceased expanding in April 1935 and fell in towards the stellar centre. Milne's theory of the Nova phenomenon is supported by these observations, the star's present state being that of a white dwarf of temperature 70,000° C. and radius one-fortieth that of the sun. The luminosity increase is explicable on Zanstra's theory as a progressive lack of equilibrium between the extreme u.v. light emitted by the star and the ionisation of the gaseous shell. G. C. McV.

**2471. Light Variations of Nova Lacertæ, 1936. H. Grouiller.** *Comptes Rendus*, 204. *pp.* 956–958, *March* 22, 1937.—An analysis of the continuous observations for the 127 days after discovery on June 18th, 1936. From these, a light curve is drawn, which also includes the individual mean probable errors [see Abstract 1551 (1936)]. The curve indicates that it is a "Flash Nova" of the same order as Nova Aquilæ (1918), but with a more rapid evolution and more uniform decadence with less marked secondary perturbations. A. S. D. M.

**2472. Spectrum of Nova Lacertæ, 1936, shortly after Maximum Light. Marie Bloch.** *Comptes Rendus*, 204. *pp.* 1055–1056, *April* 5, 1937.—About 30 spectral plates taken on June 23–October 20, 1936, at the Lyons Observatory, between $H\gamma$ and $H\zeta$, show a rapid course of the Nova, different from that of Nova Herculis in (1) the interstellar Ca and Na lines less intense; (2) large emission bands having two maxima of nearly the same intensity giving radial velocities of − 150 and + 1250 km./sec. with a central depression; (3) large absorption bands displaced towards the violet with three maxima giving radial velocities of − 3000, − 2300, and − 1800 km./sec.; (4) O II and N II emission lines are simultaneous with those of ionised metals, not following these as in Nova Herculis; (a list of elements identified is given); (5) the forbidden lines of (O I) 5577, 6300, and 6363 do not appear (as in Nova Herculis) shortly after maximum. A. S. D. M.

**2473. Humidity Effect in Astronomical Practice. J. Cuffey.** *Harvard Coll. Obs., Bull. No.* 905. *pp.* 12–14, *March* 1, 1937.—Plates subjected to moist air and then exposed were compared with control plates kept dry in a box containing $CaCl_2$ granules and similarly exposed in dry air, by means of an Eastman wedge densitometer. The differences on the magnitude scale, between the two curves were taken as the loss in speed. Curves are given for Cramer Hi-speed and Eastman I-C Special emulsions; and a table of the loss in speed at the end of a 24- and a 45-hr. exposure for several different emulsions. $CaCl_2$ storage did not give substantially better results than storage in reasonably dry conditions. A. S. D. M.

*See also* Abstracts 2432, 2462, 2463, 2475, 2498, 2586, 2616.

## SUN.

**2474. Action of Ultra-Violet Sunlight upon the Upper Atmosphere. M. N. Saha.** *Roy. Soc., Proc.* **160** *A. pp.* 155–173, *May* 18, 1937.—It is shown that a satisfactory theory of upper air phenomena, such as the luminous night sky, the ionisation in the different layers (E, F, . . .), etc., must be based on a precise knowledge of the action of u.v. sunlight (below λ3000) on molecular $O_2$ and $N_2$. The knowledge which we possess at present is summarised, and the nature of molecular ionisation and excitation, and the heights at which they occur, are discussed in detail. It is shown that, according to laboratory evidence available at present, molecular ionisation of $O_2$ and $N_2$ by photochemical action does not take place at the lowest ionisation potential, but at the second ionisation potential, *i.e.*, the photon which causes ionisation of $O_2$ and $N_2$ leaves the molecular ion excited. It is concluded that the knowledge we possess is rather scanty and does not enable us to start any adequate physical theory, beyond indicating barely the physical processes which cause such phenomena. But the discussion brings out the necessity of carrying out well-planned laboratory experiments on the absorption spectra of $O_2$ and $N_2$, without which it will not be possible to furnish an adequate explanation of upper air phenomena. The discussion also shows that the u.v. radiation from the sun differs widely from that of a black body, and in selected wave-lengths the sun must be emitting nearly a million times more photons than is given by a black body at 6500° K. This may possibly be due to the fact that the u.v. spectrum of the sun may consist of a continuous background of faint light on which are superposed emission lines of H, He, $He^+$, $Fe^+$ and other elements which are represented in the visible range by lines of subordinate series, or by patches of u.v. continuous light (near λ500) leaking through the solar atmosphere from a much hotter region inside the photosphere, as suggested by H. N. Russell. AUTHOR.

***2475. Stratosphere Solar Observatory. M. N. Saha.** *Harvard Coll. Obs., Bull. No.* 905, *pp.* 1–7, *March* 1, 1937.—The extinction of solar and stellar spectra below λ2900, by an $O_3$ layer is a great handicap. The author discusses: Cario's failure in the North Polar region through the fact that the $O_3$ content of the atmosphere increases there in winter, though the sun is absent, instead of tending to zero; and the success of Regener in sending his balloons with automatic recording apparatus into the atmosphere to a height of 31 km.; incidentally confirming that at 50 km. the $O_3$ is less than 2% of the whole. He considers the possibility of a steady programme at 40 km. high and indicates what can be observed below λ 2300 for $O_2$ and $N_2$, and the possibility of work below λ1250. Below λλ 2000 and 1700 the absorption of the Runge Schumann bands of $O_2$ may appear; λλ 1700–1250 will probably be cut off; something may be transmitted between λλ 1750–1000, but below λ 1000 no prediction can be made. A. S. D. M.

**2476. Absorption of Oxygen near 2900 Å. L. Herman.** *Comptes Rendus*, **204**. *pp.* 1035–1037, *March* 31, 1937.—A quantitative study is made of the absorption bands of $O_2$ near the u.v. limit of atmospheric transmission, in order to determine what part, if any, is played by this molecule in cutting off the solar spectrum below λ 2900. The absorption was obtained in 100 m. of $O_2$ at a pressure of 27·7 kg./cm.$^2$ The wavelengths of 6 new triplet bands between λ 2800 and λ 3000 are given. The optical density of the gas as photographically determined is tabulated for 24 wave-lengths between λ 2820 and λ 3050. Assuming that the absorption coefficient is proportional to the square of the pressure at the relatively low $O_2$ pressures prevailing terrestrially, the results show that absorption by $O_2$ near λ 2900 is negligible. Even if the influence of $N_2$ and the greater development of the Herzberg bands at low pressures render this law inapplicable, Beer's law leads to the same result. It is concluded that ozone alone is responsible for the extinction of solar radiation below λ 2900. A. Hu.

**2477. Line Contours of the Atmospheric Oxygen Bands. C. W. Allen.** *Mt. Wilson Observat., Contrib. No.* 566. *Astrophys. J.* 85. *pp.* 156–164, *April,* 1937.—The breadth and structure of the atmospheric oxygen lines are determined by studying the curves of growth of the three bands A, B, and α in the solar spectrum. True central intensities are thus computed as a function of the equivalent breadth. The absolute total absorption coefficients for the three bands are also found. [See following Abstract.] AUTHOR.

**2478. Central Intensities of Fraunhofer Lines. C. W. Allen.** *Mt. Wilson Observat., Contrib. No.* 567. *Astrophys. J.* 85. *pp.* 165–180, *April,* 1937.—The central intensities of 91 Fraunhofer lines in the red and infra-red regions of the solar spectrum are measured. The corrections for resolving power are obtained from a study of the atmospheric oxygen lines which appeared on the same plates as the solar lines. By plotting the central intensity against the equivalent breadth it is found that all observed lines are consistently wider than theory predicts. In the main, the discrepancy may be overcome by assuming that the sun's reversing layer is subject to turbulent velocities of the order of 1·6 km/sec. The discussion deals with the nature of the turbulence, the change in the structure of Fraunhofer lines with wave-length, and the causes of abnormal sharpness and breadth in individual lines, and leads to the conclusion that the observations may be explained without departing from the simple method commonly used in computing Fraunhofer contours. [See preceding Abstract.] AUTHOR.

**2479. Statistical Investigation of Intensity Variations of Fraunhofer Lines in the Solar Spectrum. A. P. H. van der Meer.** *Zeits. f. Astrophysik,* 13. 3. *pp.* 157–173, 1937.—Possible variations of Fraunhofer lines are investigated by a graphical-statistical method which is also applicable to uncalibrated plates. Investigation of photographs taken over a period of 15 years reveals variation up to 8 % and in individual cases up to 25 %. It appears when various sources of error are considered that the true variations can hardly be in excess of 4 %. Variations in solar temperature would be revealed by systematic variations in the lines; the results show that any such variation which may have occurred cannot have exceeded 2·5 %. Measurements of the intensity in Hα show that it cannot have varied by as much as 1 % of the continuous spectrum. J. E. K.

*See also* Abstracts 2487, 2515, 2841.

## ZODIACAL LIGHT AND GEGENSCHEIN.

*See* Abstract 2500.

## GEOPHYSICS.

### GEODESY.

**2480. Gravity, Geoid and Plumb-Line Deflections in Mountainous Areas. B. L. Gulatee.** *Indian Acad. Sci., Proc.* 5*A. pp.* 257–268, *March*, 1937.—Gravity anomalies at stations in the Himalayan region have been determined with four more hypotheses besides the usual Hayford's. Results indicate, that Hayford's hypothesis gives smaller residuals than the regional hypotheses of v. Meinesz and Airy, although these latter hypotheses are more logical. It appears that departures in nature from any form of isostasy are much greater than the differences between the various systems. Some of the mountainous regions of the globe, for which geoidal contours are known, are considered to see if there are any cases, in which depressed geoid is associated with an elevated region. If the geoidal elevations are taken with reference to the spheroid fitting best the area in question, it is found that for mountainous regions of the globe, for which information is available so far, the geoid and topography go together. AUTHOR.

### HYDROSPHERE, PHYSICS OF THE

**2481. Oceanographic State of the Ocean. K. Suda.** *Geophys. Mag., Tokyo,* 11. *pp.* 75–90, *Feb.,* 1937. *In English.*—Such elements as water temperature, salinity, density and velocity are considered as fundamental variables and derived variables are obtained by combination of these to determine the oceanographic state of the ocean. The graphical methods for the computation of the fundamental variabilities from observations are explained and the physical relations between the different variabilities have been studied. To illustrate a comparison has been made of the oceanographical states in the cross section of Kurosiwo off Siwonomisaki in winter and summer. The results obtained are summarised. It is hoped the method will have a prognostic value and a value in comparing different ocean currents and different parts of the same current. R. S. R.

**2482. Oscillations in an Annular Basin of Variable Depth. K. Hidaka.** *Geophys. Mag., Tokyo,* 11. *pp.* 51–74, *Feb.,* 1937. *In English.*—The free oscillations of water in an annular basin, which is divided by two radii into two sectors of different depth, is investigated. Two groups of modes were found—in one there are always loops and in the other nodes. The gravest of both modes were worked out. Lake Tôya, Hokkaidô, whose configuration closely resembles that assumed in the investigation, gave results in good accord with the theory so far as observations allowed a comparison. W. A. R.

### LAND, PHYSICS OF THE.

**2483. Elastic Constants of Soils. Part II. M. Ishimoto and K. Iida.** *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 67–86, *March,* 1937. *In English.*—The fundamental resonance frequency was determined by producing torsional vibrations of variable frequencies at the foot of the soil specimen, from which the modulus of elasticity, $\mu$, was calculated. Poisson's ratio, $\sigma$, and Young's modulus, E, were deduced from the velocity of transverse and longitudinal vibration (apparatus described in detail). For the same soils as before [see Abstract 582 (1937)] $\mu \times 10^8$, $\sigma$, and $E \times 10^8$ are for silt (recomposed) $\mu$ 0·652–4·35, $\sigma$ 0·32–0·26, E 1·71–11·0; loam (natural) $\mu$ 2·16–4·36, $\sigma$ 0·30–0·15, E 5·48–10·1; clay (recomposed) $\mu$ 0·166–3·28, $\sigma$ 0·48–0·29, E 0·502–8·50; silty clay (natural) $\mu$ 0·505–8·93, $\sigma$ 0·43–0·19, E 1·44–21·1; (recomposed) $\mu$ 0·0596, $\sigma$ 0·48, E 0·176. E and $\mu$ (especially E) decrease as moisture increase, while $\sigma$ increases. Normal and tangential viscosities are also determined. C. A. S.

**2484. Bearing Values of Soils. F. N. Kneas.** *Frank. Inst., J.* 223. *pp.* 443–462, *April*, 1937.—An account of experiments on the compressibilities of soils of various constitutions, and the movements of soil around a load. Gravel soils were found to give an upheaval around the load, but clay gave a depression. The compression at different depths below the load, and the proportion thereof recovered on removing the load were determined, and the corresponding stresses were estimated on the assumption that the stress lines spread out in truncated cone form. The application of the results to footings for a specific structure is outlined. A drop penetration test for comparing bearing values also is described. R. F. A.

**2485. Distribution of Chemical Elements in Minerals and Rocks. V. M. Goldschmidt.** *Chem. Soc. J. pp.* 655–673, *April*, 1937.—The distributions of elements in the earth's crust, the solar atmosphere and meteorites are compared, and the larger proportion of the Pt metals, and Au, Ag and Ge in meteorites and native iron pointed out. The elimination of some elements from the materials of the earth's crust is attributed to equilibria of partition between metallic or semi-metallic and silicate phases. The elements are next classified as siderophile, chalcophile and lithophile, a classification closely connected with the structure of the electron shells of the atoms, atomic and ionic radii, and ionisation potential (measured by the ratio $Z/r$, $Z$ = charge, and $r$ ionic radius). These radii have much influence on the formation of crystalline minerals, a crystal lattice acting, as it were, as a sieve; and they and the valency properties regulate the distribution of elements in the primary magmatic rocks. As regards sedimentary rocks the ionisation potential is preeminently important, and also regulates the more or less complete elimination of some elements from sea-water. Lastly the accumulation of rare elements in coal ash, and apparent connection between hydrocarbons and some elements (especially V, Ni and Mo) are discussed, and the former shown to be essentially an inorganic physical process, while the latter seems connected with the catalytic powers of these elements. C. A. S.

*See also* Abstract 2486.

## METEOROLOGY.

**2486. Radon Content of Free Air at Innsbruck and on the Hafelekar. J. A. Priebsch, G. Radinger and P. L. Dymek.** *Gerlands Beitr. z. Geophys.* 50. 1. *pp.* 55–77, 1937.—The Rn content of the atmosphere measured by a differential arrangement [see Abstract 4919 (1935)], at Innsbruck (580 m.) during Jan.–May, and on the Hafelekar

(2300 m.) during Nov.–March averaged respectively (in $10^{-18}$ curie) 312 and 100, with maxima 1560 and 275, minima 10 and 7. At Innsbruck the maximum occurs in the morning and with low temperatutes, minimum in the afternoon; pressure changes had considerable effect. On the Hafelekar, which was for most of the time snow covered, variations were smaller and irregular, increased temperature (due to Föhn) caused an increase. At both the effect of wind depended on the geology of the country over which it has passed. A snow covering caused a decrease. C. A. S.

**2487. Meteorological and Magnetic Phenomena during Solar Eclipse of June 19, 1936. N. A. Critikos.** *Gerlands. Beitr. z. Geophys.* 50. 1. *pp.* 18–21, 1937. *In French.*—The phenomena discussed were observed near Athens. After referring to the change in colour and brightness of the sky, the author deals with the alteration in temperature and humidity. A fall of 1·80° C. occurred in temperature while humidity rose from 57 % to 65 %. Variation in solar radiation was also determined. A determination of the magnetic elements gave values definitely different from those to be expected on that date. Reasons for this divergence are given. A. E. M. G.

**2488. Energy of Conditional Instability. W. Littwin.** *Monthly Weather Rev.* 64. *pp.* 397–400, *Dec.*, 1936.—Reference is made to the results obtained by Shaw and Margules regarding the energy liberated when air ascends in an unstable layer. Shaw and Refsdal also obtained from the tephigram the energy available in an unsaturated humid atmosphere. In this paper detailed calculations of energy transformations are made for processes including the cases of Margules and Refsdal. First the calculations of Margules are extended to conditionally unstable stratifications, and thus the importance of water vapour for the supply of energy is clearly shown. Next the relations between the calculations by Shaw and Refsdal of the energy for an isolated ascending element, to the calculation by Margules of the total supply of energy throughout a large closed system is shown. R. S. R.

**2489. Waves on Isentropic Surfaces as Evidenced by Interfrontal Ceiling Oscillations. W. C. Jacobs.** *Monthly Weather Rev.* 65. *pp.* 9–12, *Jan.*, 1937.—Two sets of observations were carried out on ceiling oscillations at San Diego on Jan. 15 and Feb. 22, 1936. The results are plotted and the amplitude and period of the oscillations deduced. A comparison is made with the barometric oscillations occurring at the same times. A mathematical analysis is also carried out using observational data of wind and temperature for Feb. 22. The author concludes that additional studies of these oscillations similar to the investigations on pressure oscillations may give useful information on their formation and effect on isentropic surfaces. A. E. M. G.

**2490. Non-Planetary Circulation of the Atmosphere. S. Sakuraba.** *Geophys. Mag., Tokyo,* 11. *pp.* 11–39, *Feb.*, 1937.—*In English.*—As the air motion due to longitudinal variation of air temperature which was discussed in a previous paper [see Abstract 1568 (1936)] on A. Oberbeck's theory resembles in its flow pattern the monsoon current, the author in the present paper considers further analogous relations between the sub-tropical high and the monsoon high and low. Among these are the inclination of the centre area of high and low pressure towards the equator with increasing height, the migration of the subtropical high with the migration of isothermal lines, the height of the trade wind and the monsoon wind, and the inclination of the axis of the sub-tropical high in longitudinal planes.

From a consideration of these analogies the author concludes that the monsoon phenomenon and the general circulation are of the same nature and that support is given to the thermic theory of the general circulation.
A. E. M. G.

**2491. Development of Cyclones by Amalgamation. S. Fujiwhara.** *Geophys. Mag., Tokyo,* 11. *pp.* 41–50, *Feb.,* 1937. *In English.*—Two amalgamations of systems over Eastern China and Japan are discussed. The first from 29th to 31st May, 1935, consisted of a high over the Pacific, another in the Yangtse valley and a third in north-west Manchukuo. Between these were two main lows and a number of secondaries. The second amalgamation discussed is that of a typhoon and a cyclone from 1st to 4th Oct., 1936. Both examples are illustrated by a large number of charts. A brief discussion of the method of formation of cyclones by amalgamation concludes the paper.
A. E. M. G.

**2492. Dynamics of Large Hailstones. E. G. Bilham with E. F. Relf.** *Roy. Meterolog. Soc., J.* 63. *pp.* 149–160; *Disc.,* 160–162, *April,* 1937.—The form of the relation between terminal velocity and diameter is deduced from values of the drag coefficient obtained from observations on spheres towed by aeroplanes. Values of the terminal velocity are calculated for various mean specific gravities and it is concluded that an upper limit, about 1·5 lb., is set to the mass attainable by a spherical hailstone by aerodynamical considerations.
AUTHOR.

**2493. Photometric Study of Atmospheric Pollution. W. P. Digby.** *Roy. Meteorolog. Soc., J.* 63. *pp.* 163–177; *Disc.,* 177–180, *April,* 1937.—A photometric method of comparing the loss of reflecting value through tarnishing of polished metal plates is described and shows the wide daily and seasonal effects of changes in the polluting media in the atmosphere for different metals simultaneously exposed in the same place. The different rates of tarnishing of the same metal plates exposed during the same week in rural, London and industrial areas are very marked. Extreme cases in Westminster for polished Cu are losses of 38 and 50 % in 5 hours in December fogs, whereas on 4 successive days in Feb., 1936, the loss in 5 hours varied between 5 and 11 %. For a summer day in 1935 a 10% loss in 24 hr. seems normal. For short periods of, say, 1 to 2 days in the winter and a week in the summer, Cu is a good indicator. For longer periods "fine" Ag is better. Al responds slowly while the useful range of Ni appears to be between those of Cu and of Ag. In two appendices, the loss of reflection value is correlated with independent measurements of S in the atmosphere. Further lines of research are indicated.
AUTHOR.

**2494. Size of Smoke Particles Suspended in the Air. Ouang Te-Tchao.** *Comptes Rendus,* 204. *pp.* 852–854, *March* 15, 1937.—Reference is made to the method of finding the concentration of particles of a homogeneous smoke in suspension in the air [see Abstract 587 (1937)]. Assuming the particles are spherical a simple method is used to determine their mean diameter. A mean value of $2\cdot59 \times 10^{-5}$ cm. is found. This is about half the size obtained by de Broglie from Brownian movements with tobacco smoke but it agrees with the results obtained by other known methods.
R. S. R.

**2495. Nuclei and Dust Particles in the Air of Innsbruck and Neighbourhood. R. Giner and V. F. Hess.** *Gerlands. Beitr. z. Geophys.* 50. 1. *pp.* 22–43, 1937. *English Abstract.*—Observations which were carried out at Innsbruck during 1935–36 on the content of dust particles and nuclei show that an annual variation takes place, a maximum occurring in Feb. and a minimum in June. There is also a diurnal variation with a maximum at 9 h. and a minimum in the night. Wind, rain and snow are the main factors causing changes in the numbers in both cases. An investigation of the variation of content with height showed that a diminution occurs in each case according to an exponential law. The curve showing the diminution of the content of dust particles but not that of nuclei may be derived from W. Schmidt's theory of atmospheric convection. This enables the number and size of dust particles entering the atmosphere per square kilometre to be calculated. Good agreement is found between the average size of particle so obtained and that got by measurement in the microscope. It is further shown that a variation in the number of nuclei and dust particles takes place in closed rooms similar to that in the open air but with a smaller amplitude. A. E. M. G.

**2496. Increasing Air Temperature in Large Developing Cities. H. Arakawa.** *Gerlands. Beitr. z. Geophys.* 50. 1. *pp.* 3–6, 1937. *In English.*—This investigation deals with air temperatures recorded at 21 stations in Japan over a period of 50 years. From the results of the analysis which are set out in a series of tables and also represented diagrammatically, the author concludes that there is a tendency, particulary in the colder half of the year, towards a gradual increase in temperature. A. E. M. G.

**2497. Geometrical Theory of Haloes. Part II. E. W. Woolard and C. M. Lennahan.** *Monthly Weather Rev.* 65. *pp.* 4–8, *Jan.*, 1937.—The present section deals with (1) prismatic refraction in a principal plane and (2) oblique prismatic refraction. Examples illustrate the calculation of the deviations in such cases. Tables are appended giving the values of the virtual indices and critical angles in oblique prismatic refraction for integral values of $h$ from 0° to 80°; also values of $r$ corresponding to consecutive integral values of $i$ from 0° to 90°, where $h$ increases from $h = 0°$ to $h = 80°$, by increments of 5°, and $\mu = 1{\cdot}31$; the symbols having their usual meanings. [For Part I see Abstract 1585 (1937).]
A. E. M. G.

**2498. Influence of Season and Climate on Astronomical Refraction and the Distribution of Air Masses. F. Link.** *Comptes Rendus*, 204. *pp.* 1080–1082, *April* 5, 1937.—Ramanathan's graphs for the temperature of the air as a function of altitude and latitude are used for the northern hemisphere and for the two extreme seasons of the year up to 25 km. The distribution of temperature in depressions and anticyclones given by Runye for winter and summer in central and western Europe is used, up to 16 km. The results are extended to 40 km. by using Humphrey's mean values. Two tables show the values obtained for the masses of air and the refraction. Large differences occur near the horizon but these decrease quickly away from it. The differences are due to different structure of the atmosphere and consequently refraction tables are only approximate. Examples are given in illustration. R. S. R.

**2499. Electronic Origin of Nitrogen Bands in Aurora Spectrum. R. Bernard.** *Comptes Rendus*, 204. *pp.* 993–995, *March* 22, 1937.—$N_2$ bands appearing in the aurora spectrum have been compared with those obtained experimentally from an electric discharge through $N_2$ at low pressure [see Abstract 2209 (1937)]. The agreement shown indicates that the spectrum of the Aurora Borealis has its origin in electronic excitations. W. R. A.

**2500. Photoelectric Study of the Light from the Night Sky. C. T. Elvey and F. E. Roach.** *Astrophys. J.* 85. *pp.* 213–241, *April*, 1937.—Observations of the light from the night sky are made with a recording photoelectric photometer. Records covering the entire hemisphere were made in about one hour. Observations were obtained at different hours of the night and at different seasons of the year, in order to determine the distribution of the various sources of radiation coming from the night sky. Observations of certain regions of the sky were reduced by analytical methods to evaluate the unknowns. All of the tracings, however, were reduced by a graphical method, in which all radiations having similar distributions over the sky were grouped with respect to their coordinate systems. Isophotes have been constructed for the zodiacal light, arranging the observations into four groups. There is a seasonal variation in the zodiacal light which might be interpreted as resulting from a cloud of meteoric particles which are in conjunction with the sun during the late winter months. An analysis of the light associated with the galactic system shows that after the effect of the stars has been removed there is an excess of light, which we shall call the galactic light, and which is probably produced by the scattering of starlight by interstellar matter. It also includes the galactic nebulæ. The mean amount of galactic light at latitude 0° is equal to 57 stars of the tenth photographic magnitude, or is equivalent to 5·6 mag. per square degree. Applying a theoretical discussion of scattering by Struve, it is found that the spherical albedo is probably large and that in the galactic plane the medium is opaque. AUTHORS.

*See also* Abstracts 2473, 2474, 2475.

## SEISMOLOGY.

**2501. Resonance Phenomena and Dissipation Waves. K. Sezawa and K. Kanai.** *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 1–20, *March*, 1937. *In English.*—It is shown that resonance phenomena in the stationary vibration of a semi-infinite body are possible under certain circumstances, and that a resonance-like condition, such that the displacement of the movement becomes relatively, though not excessively, large, is also possible in the forced vibration of the surface of a spherical cavity. C. A. S.

**2502. Origin of Earthquakes. Part II. W. Inouye.** *Tokyo Univ. Earthquake Research Inst., Bull.* 15. *pp.* 90–101, *March*, 1937. *In English.*—The case is investigated where the normal strain on the surface of a spherical cavity changes with varying rapidities, and it is shown that elastic waves of shock type emanate from the origin, the duration of shock being usually longer in distortional than in dilatational waves, the lengths of which are comparable with the dimensions of the origin. The range of pressure is of the order of 200–500 atmos. [For Part I see Abstract 594 (1937.] C. A. S.

## TERRESTRIAL ELECTRICITY AND MAGNETISM.

***2503. Conductivity of Air to Altitude of 22 Km. O. H. Gish and K. L. Sherman.** *Nat. Geographic Soc., Techn. Papers, Stratosphere Series, No.* 2. *pp.* 94–116, 1937.—The results of an examination of the records obtained during the flight of the balloon, Explorer II, on Nov. 11th, 1935, form the subject matter of the paper. A full description of the apparatus used and of the method of observation is first given. One of the points revealed by the investigation is that a constant ratio is found between the negative and positive conductivities. This variation from the condition found by laboratory experiments is discussed and a possible explanation offered. The ratio of the conductivities may also provide some useful measure of the water vapour content at high altitudes. Further, the air conductivity when taken in conjunction with the cosmic radiation data seems to indicate that the coefficient of recombination for small ions decreases less rapidly with decrease of pressure than is generally assumed. The authors believe that if this were definitely established then fuller information regarding the amount and distribution of dust, nuclei, etc., would be obtainable from conductivity and cosmic ray data. On this and other points they consider that more definite information is required. Several of the results are illustrated diagrammatically. A. E. M. G.

**2504. Atmospheric Electrical Conductivity and Current from Air to Earth. J. J. Nolan and P. J. Nolan.** *Roy. Irish Acad., Proc.* **43.** *pp.* **79–93,** *Feb.,* **1937.**—Measurements of conductivity were made (1) directly by using Wilson's method, (2) indirectly by counting the number of positive and negative ions and estimating their mobilities. The conductivity, measured indirectly when the effects of both types of ions are included, is found to exceed that measured directly by about 10% only. The authors conclude that it is therefore unsafe to accept the suggestion that values of air-earth current got by the indirect method are approximately double the true values. The results of the observations are given in tabular form. A. E. M. G.

**2505. Measurement of Normal Atmospheric-Electric Potential-Gradients using a Valve-Electrometer. W. A. Macky.** *Terr. Mag.* **42.** *pp.* 77–86, *March,* **1937.**—An account is given of a valve-method for measuring normal atmospheric-electric fields. The apparatus was run for one month in an exposed position subject to all types of bad weather and functioned well throughout. No difficulty at all was experienced with insulation, and the apparatus as used with a string-recorder gave a reliable record of fields up to about 400 V/m. By small alterations the range could have been increased or alternatively the apparatus made more sensitive for lower values. Comparisons with a radioactive collector and quadrant-electrometer showed that the valve-apparatus was unaffected by moist conditions which spoiled the insulation of the collector. AUTHOR.

**2506. Atmospheric Disturbances Due to Thundercloud Discharges. F. W. Chapman.** *Nature,* **139.** *pp.* **711–712,** *April* **24, 1937.**—Photographic records of electrical disturbances occurring during a thundercloud discharge, obtained with a kathode-ray oscillograph, are submitted. By means of a device in which the photographic film moves at right angles to the time-base deflection, electrical pulses only a few μsec. apart can be resolved. The records show a volley of discharges, presumably to be identified with the "brush" discharge often observed in an active cloud as a prolonged flicker or flow, followed after a brief quiescent interval by the main lightning discharge. The volley radiates a long series of electromagnetic waves producing interference in radio receivers while the main discharge consists of series of steps separated by 30–100 μsec., their quasi-period corresponding to a wave-length of 15–30 km.

**2507. Directing Influences on Lightning Strokes. B. Walter.** *Zeits. f. techn. Physik,* 18. 4. *pp.* 105–109, 1937.—Lightning flashes have been known to the author in which the flash to a higher tower was recognised. Of these the most important show the track for a certain height above, and in one case level with, the tower as a fork and from this it proceeds in a definite way to the tower. It is thus concluded that the flash in its progressive development from cloud to earth has a track to the tower which is marked by a fork. R. S. R.

**2508. Bay Disturbances in the Earth's Field. H. Hatakeyama.** *Geophys. Mag., Tokyo,* 11. *pp.* 1–10, *Feb.,* 1937. *In English.*—Three particular types of disturbance are specified, *viz.,* magnetic storm, pulsation and bay disturbance. All three are world-wide; the first lasts for one to several days, the second ranges from 20 sec. to several minutes, and the third has a duration of from one to several hours. They may occur alone or be superposed on each other or on other irregular disturbances. Positive bays occur most frequently one or two hours before local midnight, and negative bays one or two hours before noon. The two bays are phases of the same disturbance. The author has investigated the bay disturbances as recorded in magnetograms at Toyohara (S. Sakhalien) between Aug. 1, 1932 and Aug. 31, 1935. The method of dealing with the records is described, and charts are drawn of the currents in the upper air which would be necessary to cause the observed disturbances. G. E. A.

***2509. Magnetograph for Examining Sudden Changes of Magnetic Field. H. Nagaoka and T. Ikebe.** *Imp. Acad. Tokyo, Proc.* 13. *pp.* 30–33, *Feb.,* 1937.—To obtain the time rate dH/dt, of the magnetic force, H, the e.m.f. caused by the flux of induction is increased by the varying field acting upon a highly permeable material, permalloy, made up of a bundle of thin sheets. The coil has a large lateral surface but a narrow core inside the permalloy sheets. The theory of the instrument is given. An approximate value can be obtained of the time rate of variation and so an indication of rapid magnetic disturbances. The curve obtained for an electric tram distant 100 m. is shown. The apparatus is not suitable for magnetic storms. [See following Abstract]. R. S. R.

**2510. Sudden Magnetic Activity during the Volcanic Activity of Asamayama. H. Nagaoka and T. Ikebe.** *Imp. Acad. Tokyo, Proc.* 13. *pp.* 34–37, *Feb.,* 1937.—Volcanic lavas are generally magnetic when solidified and almost non-magnetic when molten. Changes in the solidification and liquefaction of volcanic lavas produce changes in the magnetic force and if the quantity of lava affected is sufficiently great the effect exceeds that due to terrestrial magnetism. The apparatus used [see preceding Abstract] was located on the volcano and shielded from changes of humidity and temperature. The records obtained show a correlation with volcanic activity. The changes in the earth's crust during volcanic activity are discussed. By using three such coils mounted horizontally the source of the activity can be found. R. S. R.

**2511. Short-Time Magnetic Fluctuations of Local Character. V. Vacquier.** *Terr. Mag.* 42. *pp.* 17–28, *March,* 1937.—The comparison of the short-time fluctuations of the earth's vertical magnetic intensity afforded by data taken during the daylight hours by the exploration troops of the Gulf Research and Development Company indicates that at points separated by 800 miles, 58 % of the fluctuations are of local origin. It is found that on a few magnetically quiet days, the time-variations of the vertical magnetic intensity are locally so different in magnitude and in phase, as to condemn the theories of magnetic variations which are based solely upon the difference between night- and day-ionisation of the upper atmosphere. The observed irregularities are independent of magnetic activity. They can be accounted for only by the dynamo-theory, and indicate the presence of local air-circulations in the ionosphere. It is suggested that simultaneous registration of the magnetic elements at points spaced about five times the ionospheric height might delineate the circulation of the upper air, and this provides perhaps information useful to meteorology. AUTHOR.

*__2512. Theory of the Unifilar Variometer. H. H. Howe.__ *Terr. Mag.* **42.** *pp.* **29–42,** *March,* **1937.**—After describing briefly the various types of variometer the author deduces the fundamental scale value equation and then proceeds to discuss first H- and D-variometers. Vectors are used in the treatment. The subject is then approached from a more general point of view. First H is regarded as a function of *n* (ordinate on the magnetorgram) D (declination) and *t* (temperature). The result of this analysis indicates that (1) this method avoids mistakes made when second order effects are considered : (2) when properly defined the temperature coefficient is independent of ordinate and declination : (3) error has resulted by using the wrong sign for the temperature coefficient of rigidity of quartz. Variations of scale values are investigated and results obtained. Then the D-variometer is considered, D being taken as a function of *n*, H and *t*. It is found here that (1) the scale value may have considerable error unless corrected for the field of other magnets. (2) the effect of change of H is small : (3) error in orientation may be detected from the temperature coefficient. Similar methods are also applied to variometers arranged to measure variations in fixed directions. The paper concludes with some suggestions for possible improvments in design and operation. A. E. M. G.

**2513. Annual Period of Magnetic Elements. K. F. Wasserfall.** *Terr. Mag.* **42.** *pp.* **43–44,** *March,* **1937.**—This note deals with the annual variation of the elements at Dombås Observatory, Norway, for each of the 24 hours. The period investigated is 1923–33. Residuals between the 11-year mean and that for quiet days of each month for each of the 24 hours are plotted against the time. Three sets of 24 diagrams each give the variations in declination, horizontal and vertical intensities. A. E. M. G.

*__2514. Hansteen's Magnetic Instrument. K. F. Wasserfall.__ *Terr. Mag.* **42.** *pp.* **45–47,** *March,* **1937.**—A description of the instrument is given and two recent photographs are reproduced. The method adopted by Hansteen in carrying out observations and some of the results found are referred to. A. E. M. G.

**2515. Solar and Magnetic Conditions Associated with Recent Auroræ. J. P. Rowland.** *Nature,* **139.** *pp.* **680–681,** *April* **17, 1937.**—Recent aurora displays are shown to have been in possible relation with the presence of sunspots in such positions on the sun that radially projected corpuscles therefrom might be expected to reach the earth in large numbers at the required times if their velocities were 217–280 miles per sec. To spots in less favourable positions little or no terrestrial effects correspond in this fashion. C. A. S.

*See also* Abstracts 2487, 2585.

## RADIOACTIVITY.

**2516. Distribution in Time of Counts Due to a Constant Source and Its Daughter in Equilibrium. L. Devol and A. Ruark.** *Phys. Rev.* 51. *pp.* 710–712, *May* 1, 1937.—An expression is obtained for the size distribution function of the time intervals between counts caused by a constant source and its daughter substance in equilibrium. The efficiency of the detector and its finite recovery time are taken into account. The results apply also to counts caused by bombarding particles and artificially radioactive atoms which they produce. [See also Abstract 2122 (1936).] AUTHORS.

**2517. Existence of a Thor-Polonium. S. Meyer.** *Akad. Wiss. Wien, Ber.* 145. 2*a*. 9–10. *pp.* 577–582, 1936.—A detailed comparative study is made of the three radioactive series, Ra, Th and Ac, and on the basis of this it is suggested that a long-lived Po isotope in the Th family may exist. From the relative proportions of the Pb isotopes 208 and 204 it is shown that the half-life of the Th-Po is probably $1 \cdot 8 \times 10^{12}$ years; the range in air of the emitted $\alpha$ particles would be 2 cm. In addition to Pb isotopes of atomic weight 208, 206, 207 and 204, it is suggested that 210 and 203 should be observed. J. E. R.

**2518. Age of a Canadian Uraninite. F. H. Bruner.** *J. Phys. Chem.* 41. *pp.* 365–373, *March*, 1937.—The uraninite came from Beaver Lodge Lake, S.E. of Great Bear Lake. It contains $U_3O_8$ 51·45%, $Fe_2O_3$ 41·51, Pb 2·31, with small amounts of $SiO_2$, $Al_2O_3$, and CaO. The Pb-U ratio, determined by the previous method [see Abstract 1544 (1935)] is 0·0529, indicating an age of $390 \times 10^6$ years, and very different from that ($1323 \times 10^6$ years) of uraninite from the Great Bear Lake itself [see Abstract 2126 (1936)], and indicating a quite different origin. The Pa-U and Ac-Io ratios are both 0·04. C. A. S.

**2519. Regularities in Nuclear Levels of Radioactive Atoms. S. Rosenblum and M. Guillot.** *Comptes Rendus*, 204. *pp.* 975–977, *March* 22, 1937.—Additional examples are given of regular differences in the energies of lines in the $\beta$-ray spectra accompanying the changes $ThB \rightarrow ThC$, $AcB \rightarrow AcC$, and in the $\alpha$-ray spectra of ThC′ and RaC′.

C. A. S.

**2520. Electrochemistry of Polonium. M. Haïssinsky.** *Am. Electrochem. Soc., Trans.* 70. *pp.* 343–371, 1936.—The electrochemical behaviour of Po is described and it is pointed out that there is a decided tendency to form complexes, a variety of kations and anions being possible. Po deposits readily from solution, by displacement, on a large variety of metals. The electrodeposition of Po is largely dependent upon the PH of the bath and upon the presence of salts. Complications arise from the effects of the $\alpha$-radiation from the Po. In alkaline baths deposition takes place at both electrodes. Po may also be present as a colloid and may then be adsorbed on silica and other bases. A brief summary is given of methods available for recovering Po from radio-lead deposits and from old radium ampoules. J. E. R. C.

**2521. Decomposition of Air-free Water by $\alpha$-Rays. C. E. Nurnburger.** *J. Phys. Chem.* 41. *pp.* 431–435, *March*, 1937.—Experiments are described showing that $\alpha$-rays decompose air-free water, their action thus being different from that of X-rays which do not do this. C. A. S.

**2522. Formation of Benzene in the Radiochemical Polymerisation of Acetylene. W. Mund and C. Rosenblum.** *J. Phys. Chem.* 41. *pp.* 469–475, *March,* 1937.—Absorption spectra of acetylene polymerising under the influence of radon are photographed. By this means the formation of benzene is demonstrated for both the α-ray and the β-γ-ray reactions. That cuprene is not the only polymer produced in appreciable quantities was shown by freezing out in a $CO_2$-acetone mixture a solid which proved to be a volatile liquid at room-temperature. This liquid was chiefly benzene. It appears as a result of a reaction proceeding simultaneously with cuprene formation. AUTHORS.

**2523. Distribution of α-Tracks. Marietta Blau and Hertha Wambacher.** *Akad. Wiss. Wien, Ber.* 145. 2*a*. 9–10. *pp.* 605–609, 1936.—A photographic investigation made by Wilkins of the α-particle tracks produced by atoms of the Ra disintegration series yielded results for their distribution which were not in agreement with the theory of radio active disintegration. This research has here been repeated photographically and has not confirmed Wilkins' results. The distribution of single tracks and the angle between several tracks arising from the same initial point are found to correspond to the requirements of the theory. G. O. B.

**2524. Scattering of α-Particles in He, $H_2$ and $D_2$. C. B. O. Mohr and G. E. Pringle.** *Roy. Soc., Proc.* 160*A*. *pp.* 190–206, *May* 18, 1937.—The scattering of α-particles of Po has been observed in He, $H_2$ and $D_2$ over a region of different velocities and scattering angles. The scattering associated with Coulomb fields takes place only at ranges much lower than was previously thought. This indicates departure from the Coulomb law of force at distances greater than $10^{-12}$ cm. The ratio of observed to "classical" scattering was found to be large for $H_2$ and $D_2$, but the results for He were found generally to be lower than previous estimates. The results are interpreted in terms of a nuclear potential of the Gamow type. The resulting nuclear potentials are discussed. They can be made to conform with data on the binding energies of nuclei. AUTHOR.

**2525. Wilson Cloud Chamber Investigation of the α-Particles from Uranium. W. M. Rayton and T. R. Wilkins.** *Phys. Rev.* 51. *pp.* 818–825, *May* 15, 1937.—The mean ranges of the α-particles emitted by uranium have been determined in terms of the mean range of Po α-particles. The ratios obtained for the mean ranges are, for U I/Po, 0·6904 ± 0·0007, and for U II/Po, 0·8357 ± 0·0008. These correspond to mean air ranges of 2·63 and 3·18 cm., for the particles from U I and U II, respectively, in dry air at normal pressure and at 15° C. on the basis of the present Po value of 3·80 cm. The straggling coefficient was determined for the Po α-particles used as the reference range group in the experiment and gave a value considerably closer to theoretical prediction than the usual experimental results. Possible evidence for the existence of a new α-emitting isotope of U is suggested in the data. The mean air range for the new group is believed to be in the vicinity of 2·9 cm. An identification with the actino-uranium isotope of approximately this range suggested by Wilkins as the parent of the Ac series and with Dempster's 235 U isotope is proposed. AUTHORS.

**2526. Ranges and Straggling Coefficents of α-Particles. A. King and W. M. Rayton.** *Phys. Rev.* 51. *pp.* 826–831, *May* 15, 1937.—A review and evaluation of the analytical and graphical methods customarily applied in range determinations reveals several types of errors that frequently have been overlooked. Of particular importance are the area and error effects. The extrapolated range is shown to be subject to other errors and it is concluded, therefore, that the mean range is much the best measure of range. A method of analysis which takes into account these errors is developed and applied to a set of polonium data. The experimental straggling coefficient is only 13 % greater than the Bethe-Williams theoretical value and 20 % greater than the Bohr value. AUTHORS.

**2527. Range-Grouping of Natural H-Rays. W. Volland.** *Zeits. f. Physik*, 105. 1–2. *pp.* 104–113, 1937.—An experimental investigation is made of the H-rays liberated from thin layers of paraffin by bombardment with α-rays from Po. It is shown that with decreasing energy of the α-rays no monotonic decrease of the number of H-rays exists. In agreement with other workers, the curve of number of H-particles against α-particle velocity is found to have two minima. Comparison of the early theory for the scattering of Rutherford and Darwin with experiment, shows that there is a discrepancy by a factor of approximately 100. Calculated values based on the laws of wave mechanics yield better agreement as far as order of magnitude is concerned. Interpretation of the results in the light of Wentzel's theory leads to a determination of the values of the separate quantum states. G. O. B.

**2528. Absorption Curves and Ranges for Homogeneous β-Rays. J. S. Marshall and A. G. Ward.** *Canad. J. of Research*, 15. *Sect. A. pp.* 39–41, *March*, 1937.—β-rays were bent in a uniform magnetic field, after which they entered, as approximately homogeneous rays, an ionisation chamber connected to a linear amplifier. Absorption curves in Al were determined for various values of Hρ. The active materials were Ra E and U X. AUTHORS.

**2529. End Points of β-Ray Spectra of Radium E and Uranium $X_2$. A. G. Ward and J. A. Gray.** *Canad. J. of Research*, 15. *Sect. A. pp.* 42–44, *March*, 1937.—The end points of the β-ray spectra of Ra E and U $X_2$ have been measured, using semi-circular magnetic focusing and an ionisation chamber connected to a linear amplifier. Experimental results give end points of $H\rho = 5250$ guass-cm. for Ra E and $H\rho = 9300$ gauss-cm. for U $X_2$. AUTHORS.

**2530. Dependence of the β-Spectra of Radioactive Elements on the Atomic Number. A. I. Alichanian, A. I. Alichanow and B. S. Dželepow.** *Phys. Zeits. d. Sowjetunion*, 11. 2. *pp.* 204–224, 1937. *In English.*—It is shown that the form of the β-spectrum is markedly dependent on the atomic number of the radioactive substance. In contradiction to the classical experimental data it appears that the curve showing the energy distribution of electrons from RaE has practically no maximum, *i.e.*, by decreasing the energy down to 30 kV the number of electrons hardly decreases at all. In the case of light radioactive bodies like RaAl and RaP the electron distribution curve commences at the origin of coordinates and shows a sharp maximum. AUTHORS.

**2531. Generalised Fermi Interaction. F. Hoyle.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 277–292, *April*, 1937.—Konopinski and Uhlenbeck have shown that the empirical β-ray spectra seem to require a modification of Fermi's original expression for the interaction leading to $\beta$ decay. Their expression includes a derivative of the neutrino wave function. In the present paper the most general type of such an interaction term and the possibility of introducing second-order derivatives are investigated. It is shown that, besides the Fermi and the K-U modified terms there is a large number of possible expressions satisfying the requirements of Lorentz invariance. Of these the terms containing one first-order derivative differ from the K-U distribution only at low energies, and this could be accounted for by the general expressions deduced. If the neutrino has a mass it is similarly possible to modify the distribution near the upper limit. From consideration of the connection between the $\beta$-decay and nuclear forces it is shown that, amongst the many possible terms of the second order, combinations can be found which resemble the empirical curves equally as well as those with first derivatives. N. M. B.

**2532. Theory of $\beta$-Radioactivity. A. Mercier.** *Comples Rendus*, **204.** *pp.* 1117–1119, *April* 12, 1937.—The probabilities of the two following phenomena are considered by the theory of Fermi. (1) A nucleus of an atom absorbs an electron from the K level having energy $W_e$, with emission of an anti-neutrino of energy $W\sigma$. (2) A proton in a nucleus emits a positron of energy $- W_s$ and an anti-neutrino of energy $W\sigma$, thus losing a net amount of energy $W_o$. The numerical results of the calculations are given in graphs and tables. G. O. B.

**2533. Shape of $\beta$-Ray Distribution Curve of Radium E at High Energies. L. M. Langer and M. D. Whitaker.** *Phys. Rev.* **51.** *pp.* 713–717, *May* 1, 1937.—The $\beta$-ray spectrum of Ra E was measured by means of a magnetic spectrometer and coincident counters with special emphasis on the shape of the curve near the end-point. Because of the strong source available, and the low background of the detecting mechanism, it was possible to obtain significant data much closer to the end-point than has been done heretofore. The distribution was found to end, without a tail, at $H\rho = 5330$ oersted-cm., or $1 \cdot 17 \times 10^6$ eV. The Fermi and K-U plots of the experimental data do not give straight lines as predicted by the theory. Extrapolation of the straight part of the K-U plot gives an end-point 17 % higher than that observed. AUTHORS.

*See also* Abstracts 2284, 2285, 2286, 2296, 2303, 2316, 2317, 2318, 2440, 2486, 2559, 2835.

# RADIATION.

## ABSORPTION AND TRANSMISSION.

**2534. Influence of Temperature and Preliminary Irradiation on the Absorption of Light in $Cu_2O$. S. I. Goloub and A. Koulew.** *Phys. Zeits. d. Sowjetunion,* 11. 2. *pp.* 168–181, 1937. *In French.*—The absorption of $Cu_2O$ is shown to be diminished by preliminary irradiation with red light but increased by irradiation with blue. Heating also increases the transparency of $Cu_2O$ layers. C. B. A.

**2535. Ultra-Violet Absorption of Binary Liquid Mixtures. M. Pestemer, H. Flaschka and R. Skrabal.** *Zeits. f. Elektrochem.* 43. *pp.* 297–302, *May,* 1937.—It is shown that Beer's law is not valid for the binary systems $CS_2$ : hexane and $CS_2$ : acetone. Review of the experimental evidence available suggests that the variations of molecular extinction coefficient with concentration can be explained by the presence of various associated molecular complexes. C. B. A.

***2536. Determination of Minute Absorptions of Light. A. van Kreveld and H. J. Jurriëns.** *Physica,* 4. *pp.* 297–304, *April,* 1937. *In English.*—Describes a method of measurement of very small colorations produced by photochemical reaction. The apparatus used consists of a carrier on which the photographic material is mounted, and a measuring light which falls on a Weston photronic cell, after passing through a water filter, a red glass, an opal glass, the photographic layer and another opal glass. The cell is connected to a Moll galvanometer, the deflections of which are recorded photographically. Details of the method of use of the apparatus and the determination of the coloration from the registrograms, are briefly given. Finally, the additional corrections due to the use of the opal glasses in the path of the measuring light are mathematically developed. [See also Abstract 2563 (1937).] R. C. F.

## COLORIMETRY.

***2537. Natural Colour System. R. H. Sinden.** *J.O.S.A.* 27 *pp.* 124–131, *March,* 1937.—Repeated attempts have been made to correlate experimental data on chromatic difference thresholds with the trichromatic coefficients of the spectral and non-spectral colours. The author shows that such a correlation with Helmholtz's theoretical treatment is possible in the case of modern colorimetric threshold data and he describes the theory upon which it can be based. Apparatus employed for the most convenient application of the method is described and the numerical results will be given in a later paper. J. W. T. W.

***2538. Colour Separator. W. Richter.** *Electronics,* 10. *pp.* 28–29, *March,* 1937.—The apparatus described is intended for the detection of differences in colour of the light reflected from different materials. Similar images of an illuminated area of the sample are made to fall on two photoelectric cells, with the aid of a partially reflecting, partially transmitting mirror. In front of the two cells are placed colour filters of different types, and also neutral wedges. The cells are connected in a circuit arranged to show the difference in their photoelectric currents. The wedges are adjusted to give no difference of current when a neutral-colour sample is employed. With coloured samples the difference current is a " measure " of the colour. W. S. S.

**2539. Colorimetry in Industry. A. C. Hardy.** *J. of Applied Physics*, 8. *pp.* 233–238, *April*, 1937.—A general description, in popular form, of the basis of colour measurement and of the practical uses of colorimetry. The importance of the I.C.I. system of primaries and visual characteristics is emphasised. J. W. T. W.

**2540. Theoretical Basis of Colour Printing. H. E. J. Neugebauer.** *Zeits. f. wiss. Phot.* 36. *pp.* 73–89, *April*, 1937.—In a theoretical treatment, checked by measurements of coloured printing, the author shows that the colours of a plate follow the laws of additive colour mixture, the components being the three original colours and their subtractive mixtures. The expressions derived from this theory may be based, as far as quantitative proportions in the mixture are concerned, on the laws of probability. The ideally best colours for faithful reproduction are derived and their characteristics are compared with those of the colours actually available. J. W. T. W.

## ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

**2541. Electrical Birefringence of Mixtures of Nitrobenzene and Hexane. L. Kozlowski.** *Acad. Polonaise Sci. et Lettres, Bull.* 10*A*. *pp.* 575–585, *Dec.*, 1936. *In English.*—A strong rise of the Kerr constant is found near the critical point of dissolution of a mixture of hexane and nitrobenzene. Mixtures of benzene and nitrobenzene are investigated which show no such anomaly. The validity of Kerr's law in the vicinity of the critical point is proved. AUTHOR.

**2542. Kerr Effect of Nitrobenzene in Benzene. H. Friedrich.** *Phys. Zeits.* 38. *pp.* 318–329, *May* 1, 1937.—A study of association is made by means of measurements of the variation with concentration (0–100 %) of the Kerr effect of nitrobenzene dissolved in benzene. The results are interpreted on the basis of restricted possibility of rotation of liquid molecules. The corresponding energy is calculated as a function of concentration, and it is shown that the probability of free rotation decreases with increasing concentration, the effect being greatest at low concentrations. C. B. A.

**2543. Magneto-Optical Rotation and Natural Dispersion in Gases. A. Okazaki.** *Ryojun Coll. Eng., Mem.* 10. *pp.* 19–25, *Feb.*, 1937. *In English.*—Natural dispersion formulæ of Ketteler-Helmholtz type, with a single u.v. absorption term, together with Becquerel's formula for magneto-optical dispersion have been found to fit the experimental data in the case of the gases, $H_2$, CO, $H_2S$, CN, $SO_2$, $CH_3Cl$ and gaseous $CHCl_3$. The computed wave-lengths of absorption bands lie within the experimentally determined bands for these gases, except for CN and $CHCl_3$ for which the observations have not been extended to the extreme u.v. region in question. Constants of the two dispersion formulæ and the calculated values of $e/m$ for the dispersion electrons are given. [See also Abstract 3142 (1936)]. AUTHOR.

**2544. Magneto-Optical Rotation and Natural Dispersion of Heavy Water. A. Okazaki.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 286–294, *March*, 1937.—By the use of Slack's data for Verdet's constants of $H_2O$, $D_2O$ and a mixture of $H_2O$ and $D_2O$ for 5893 and 5461 Å, the corrected molecular rotations $M[D]$ of $H_2O$, HDO and $D_2O$ are calculated for these wave-lengths. The formulæ for the dispersion of molecular refraction of $H_2O$, HDO and $D_2O$ are derived from Luten's data for the refractive indices of $H_2O$, $D_2O$ and their mixture in the region from 6563 to 4358 Å. With these $M[D]$—values and dispersion formulæ and by the application of Becquerel's formula, the magneto-optical anomaly $\gamma$ of $H_2O$, HDO and $D_2O$ is evaluated. AUTHOR.

## FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

**2545. Influence of Solvent Viscosity on the Polarisation of Fluorescent Light. P. Pringsheim and H. Vogels.** *J. de Physique et le Radium*, 8. *pp.* 121–124, *April*, 1937.—The authors investigate the degree of polarisation $p$ in the fluorescent light emitted by solutions of certain dye-stuffs in solvents of different viscosities $\eta$. The excitation was by light of effective wave-length 3700 Å. Results are given for trypaflavine and fluorescein dissolved in various alcohols, the viscosity of the solutions being altered by adding ether, in which the dyes are insoluble. Graphs connecting $1/p$ with $1/\eta$ are straight lines (Perrin's law) for these mixtures, but not for mixtures of glycerin and water, in both of which the dyes dissolve. The fundamental polarisation $p_0$ (at $\eta = \infty$) is also much greater in the latter case. It is suggested that the fluorescent molecule retains a certain rotational mobility within a layer of adsorbed solvent molecules surrounding it and preventing translational motion. In any case, it seems necessary to introduce into Perrin's formula a value for $\eta$ which is not that determined by diffusion methods or indeed by any macroscopic means; a conclusion throwing light on anomalies previously noted by Debye [see Abstract 4318 (1934)] and by Cram [see Abstract 615 (1937)]. A. Hu.

**2546. X-Ray Fluorescence Yields. R. J. Stephenson.** *Phys. Rev.* 51. *pp.* 637–642, *April* 15, 1937.—The X-ray fluorescence yield for the K-shell of atoms has been measured for a number of elements ranging from Ni to Sn by an ionisation chamber method similar to that developed by A. H. Compton. The results show an increase in the fluorescence yield with atomic number and are compared with those calculated by Massey and Burhop using relativistic wave mechanics and also with those calculated by Burhop from non-relativistic wave mechanics. The fluorescence yield for the $L_{111}$ shell of Pb, Th and U has been determined using suitable exciting radiation. An increase in the yield with atomic number is found. AUTHOR.

**2547. Chemistry of Sulphide Phosphors. R. Schenck.** *Naturwiss.* 25. *pp.* 260–269, *April* 23, 1937.—To investigate the nature of sulphide phosphors, $H_2$ has been passed over them at constant temperature and the resulting reactions followed by analysing the gas at intervals. The results are plotted in the form of graphs showing percentage of $H_2S$ against percentage of S in the heavy metal sulphide left. The graphs show a more effective reduction for the pure heavy metal sulphide than for the phosphors, indicating some intimate union of the heavy metal sulphide with the base sulphide. This is taken to mean the formation of double polysulphides and a number of formulæ are suggested. In the case of sulphides such as $Cu_2S$ and PbS which are not reducible by $H_2S$ an indirect method has been adopted. If one of these is incorporated as well as a reducible sulphide with say CaS and the $H_2$ reaction then carried out it is found that less of the reducible sulphide is reduced. This is taken to show that part of the alkali-earth sulphide is taken up by reaction with the non-reducible sulphide. In some cases however as $Bi_2S_3$ or $Ag_2S$ in CaS where the affinity of the S is greater for the alkali metal no complex anions are formed. In those cases where complex anions are assumed it is supposed, following Lenard, that there may be several kinds of complex anions giving different kinds of centres with the same metal. An attempt is made to correlate the optical and chemical data. J. E.

**2548. Phosphorescence of Kathode-Ray Oscillograms on Screens with Slow Decay Speeds. M. v. Ardenne.** *Zeits. f. Physik,* 105. 3–4. *pp.* 193–201, 1937.—Experiments on the decay of phosphorescence of phosphors excited by kathode rays or by light are described. Under excitation by light, the phosphorescence decays rapidly if the time of illumination is less than that required for complete excitation of the phosphor. With moving electron beams, measurements of the decay period as a function of the " scribing " speed indicate that this speed cannot be increased by increasing the intensity of the electron beam, on account of a saturation phenomenon. C. B. A.

**2549. Attempt to Detect Metastable Atoms in Active Nitrogen. W. S. Herbert, G. Herzberg and G. A. Mills.** *Canad. J. of Research,* 15. *Sect. A. pp.* 35–38, *March,* 1937.—In order to explain the nitrogen afterglow, Cario and Kaplan [see Abstract 1649 (1930)] have assumed the presence of metastable $^2D$ and $^2P$ atoms in active N. The N emission lines at 1492 and 1742 Å have these metastable states as lower states, and should therefore be absorbed by active N. However, no absorption has been found by the writers. This leads to 1/6000 % as an upper limit for the stationary concentration of metastable atoms in active N, which is compatible with the experiments. In order to account for the observed intensity of the afterglow, on the basis of Cario-Kaplan's theory, a lifetime of the metastable $^2P$ atoms $\leqq 8 \times 10^{-4}$ sec. has to be assumed and a concentration of metastable molecules greater than 1/330 %. AUTHORS.

**2550. Triboluminescence. Frances G. Wick.** *Akad. Wiss. Wien, Ber.* 145. 2*a*. 9–10. *pp.* 689–705, 1936.—Three factors are concerned in triboluminescence, contributing either singly or together to the phenomenon: (1) Radiation from non-permanent centres which are excited by kathode rays or radium dosage. (2) Radiation from permanent centres, characteristic of the substance and heat resistant. These are independent of the kind of excitation. (3) Electric discharges in air giving $N_2$ bands. The triboluminescence is similar to thermoluminescence and is exhibited by substances which are excited to phosphorescence or thermoluminescence by radioactive radiations, X-rays or kathode rays. Generally it is similar to the thermoluminescence at low temperatures. The principle of the identity of luminescence spectra, whatever the means of excitation, is again established. This is particularly obvious in the case of the narrow bands of the rare-earth activated fluorites. Tribothermoluminescence is only shown by those substances which can be excited to a stable thermoluminescence at high temperatures by radioactive radiations, kathode rays or X-rays. Triboluminescence is like other kinds of luminescence in that it is influenced by heat, is affected adversely or advantageously by different impurities and seems to require the presence of impurities. With synthetic fluorites containing rare earths, and a number of natural minerals it is found that all three factors above are operative. After heating in a blowpipe flame only (2) and (3) and after melting in the flame only (2) are operative. With $MgSO_4$, $CdSO_4$, $Na_2SO_4$ and $CaCO_3$ containing 1% Mn only (1) is operative. J. E.

**2551. Emission of Visible Light from Cavitated Liquids. L. A. Chambers.** *J. Chem. Phys.* 5. *pp.* 290–292, *May*, 1937.—Emission of visible light from a number (14) of pure liquids and from some aqueous and non-aqueous solutions occurs during cavitation by intense sound waves of 8900 c.p.s. The intensity of the visible components of the radiation varies directly with the numerical product of viscosity (in poise) and dipole moment (in Debye units) and inversely with the temperature. In the case of polar solutes in nonpolar solvents the intensity varies with the concentration of the dipole. The light originates in cavitated areas or at the surface of the cavities, and is therefore proportional to the amount of cavitation, and in consequence, to the acoustic power input. AUTHOR.

**2552. Brightness of Kathodo-Luminescence at Low Current Densities and Low Voltages. T. B. Brown.** *J.O.S.A.* 27. *pp.* 186–192, *May*, 1937.—With artificial willemite as the luminescent substance, it is found that, for sufficiently low current densities, J, and for accelerating potentials, V, between 200 and 800 V, the brightness of luminescence, B, is given quite accurately by $B = KJV^3$. This empirical equation gives too high values if J exceeds a limiting value which depends upon the accelerating potential, and which becomes lower as the potential is raised. From 800 to 1500 V the agreement is only approximate, B increasing somewhat more rapidly than the equation indicates. There is no indication of the existence of a "threshold" voltage for this material. The chief difficulty encountered in working at these low accelerating potentials is the uncertainty concerning the potential of the surface of the luminescent target, and one important aspect of the present work is the development of experimental means to determine the potential of this surface to within the limits of experimental error of the other measurements. It is shown that when the target is very carefully shielded electrostatically the secondary emission from it will maintain its potential within a very few volts negative to the potential of the shield, over the entire range of voltages used. AUTHOR.

## INTERFERENCE, DIFFRACTION AND SCATTERING.

**2553. Interference by Reflection from a Concave Spherical Mirror. O. U. Vonwiller.** *Roy. Soc. N.S. Wales, J. and Proc.* 70. *pp.* 302–321, 1937.—Interference bands may be obtained when light is reflected at large angles of incidence from a spherical concave mirror as the result of the superposition of beams which have been reflected different numbers of times. The conditions under which the bands may occur are determined and the ranges over which the various interference systems may be described for a given mirror are evaluated. An investigation is made of the intensities of the various band systems. These bands provide a convenient experiment for a reasonably accurate class determination of the wave-length of light. AUTHOR.

*See also* Abstracts 2326, 2327, 2743.

## PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

**2554. Reaction of Bichromate with Formate under the Action of Light. H. A. Brass.** *Zeits. f. wiss. Phot.* 36. *pp.* 33–48, *Feb. and pp.* 49–58, *March*, 1937.—The properties of the system bichromate-formate-formic acid are briefly summarised with special reference to the influence of light. Experimental photochemical investigations in the region pH = 1·5 to 7·0 using a quartz Hg lamp are made, from which the following conclusions are drawn: (*a*) the photochemical reaction at pH<4 yields green Cr ions and $CO_2$, the amount of the latter evolved being equivalent to the decrease in Cr concentrations; (*b*) the bichromate decomposition takes place according to the equation $Cr_2O_7^{=} + 3HCOO^- + 4\ H_2O = 2\ Cr^{+++} + 3\ CO_2 + 11\ OH^-$. In the region pH = 2·5 to 4·5, the reaction is linear with time, suggesting that the reaction velocity is independent of the bichromate concentration. When pH>4, chromic chromate is formed as an intermediate stage in the reaction and the proportion of Cr (6) and Cr (3) in this compound may be shown to be 1 : 2 by conductivity measurements. Below pH = 2·5 a dark reaction occurs. The reaction velocity is approximately proportional to the formate ion concentration and the pH of the system is of secondary importance in systems where pH<4·5. The temperature coefficient between + 20 and + 50° C. is given as approximately 1. The addition of small amounts of heavy metal ions causes the reaction to accelerate in the case of $Fe^{++}$, $Fe^{+++}$ and Mo (6) but to decelerate for $Ce^{+++}$. The addition of a neutral salt ($MgSO_4$) leads to some interesting phenomena, of which a description is given. H. J. H. S.

**2555. Decomposition of Chlorine Monoxide in Green Light. A. G. Brown and J. W. T. Spinks.** *Canad. J. of Research*, 15, *Sect. B*, *pp*. 113–123, *March*, 1937.—$Cl_2O$ undergoes a Br-sensitised decomposition in light of wave-length 5460 Å. The reaction involves short chains and is accompanied by an appreciable dark reaction. The quantum yield is 4·3 at 19° C. A decrease in pressure occurring near the end of the reaction has been shown to be a photochemical effect, and it is due probably to the Br-sensitised decomposition of $ClO_2$ formed during the combined light and dark reactions. A mechanism similar to that described by Finkelnburg, Schumacher and Stieger for the unsensitised reaction appears to account for most of the observations. [See Abstract 2187 (1932).] AUTHORS.

**2556. Photodecomposition of Gaseous Acetone. R. Spence and W. Wild.** *Chem. Soc., J. pp*. 352–361, *March*, 1937.—The absorption of light by acetone in the region of continuous absorption yields methane, ethane, carbon monoxide, and diacetyl, as a result of the primary process $(CH_3)_2CO + h\nu \rightarrow CH_3 + CH_3 \cdot CO$. The ratio $C_2H_6/CO$ increases with increasing intensity of continuum light to a maximum value of about 2·5, and an equation has been deduced from a probable mechanism which accounts for this behaviour. It is suggested that light absorption in the banded region leads to the production of an excited molecule which may dissociate directly into $C_2H_6$ and CO without the intervention of radicals. With the full light of the Hg arc at 20°, the ratio $C_2H_6/CO$ increases to a maximum value of about 1·9, and then decreases to 1·5 as the light intensity is increased. This can be explained if it is supposed that the excited molecules produced in the band region intereact with acetyl radicals arising from the absorption of light in the continuum. The effective life of the acetyl radical rapidly decreases as the temperature is raised. Increase of acetone pressure or decrease of light intensity increases the proportion of methane in the products at 60°, owing to the operation of the reaction $CH_3 + (CH_3)_2CO \rightarrow CH_4 + \cdot CH_2 \cdot CO \cdot CH_3$. AUTHORS.

**2557. Free Radicals and Atoms in Primary Photochemical Processes. H. H. Glazebrook and T. G. Pearson.** *Chem. Soc., J. pp.* 567–571, *April,* 1937.—The relative quantities of radicals present during the photolysis of acetone, methyl ethyl, methyl *n*-propyl, methyl *iso*propyl, methyl *n*-butyl, di-*n*-propyl, and di*iso*propyl ketones have been measured, and radicals have been obtained from di-*tert.*-butyl and di-*sec.*-butyl ketones. The acetyl and methyl radicals are formed in comparable quantities during the photo-dissociation of acetone by u.v. light at room-temperature. Acetyl radicals rapidly combine with one another to form diacetyl. Under the present experimental conditions acetyl has a short life compared with the alkyl radicals; it is quantitatively decomposed on a silica surface at 60°, and is removed by Te at the room-temperature. AUTHORS.

**2558. Blackening of Films and Plates. P. M. Wolf and N. Riehl.** *Zeits. f. techn. Physik,* 18. 4. *pp.* 89–90, 1937.—Discusses briefly a new method for the measurement of the blackening of films or plates of any type, in which u.v. light, after passing through the developed film, falls on a fluorescent screen, the visible light thus produced having to pass again through the film. By this means the measured blackening has twice the value obtained using visible light. R. C. F.

**2559. Response of Desensitised Photographic Plates to $\gamma$-Radiation. E. Schäfler.** *Akad. Wiss. Wien, Ber.* 145. 2*a*. 9–10. *pp.* 567–575, 1936.—Discusses the results obtained from an examination of plates desensitised with pinakryptol yellow and subjected to $\gamma$-rays in air and in a vacuum. With under-development, after elimination of a development effect due to pinakryptol yellow, a "rest effect" is obtained on desensitising in a vacuum. The effect of different gases ($H_2$, $N_2$ and $O_2$) on the blackening due to $\gamma$-rays shows that such blackening is dependent on the gas used, the effects being more pronounced with desensitised plates than with normal plates. These results can be explained on the assumption of an oxidation brought about by the desensitiser used. An increase in blackening produced is obtained with increase in temperature, and brief mention is also made of the different behaviour of desensitised plates to $\gamma$- and corpuscular radiations. An increase in blackening by exposure, in vacuum, of a desensitised plate is shown to be a development effect thus giving evidence of desensitiser blackening, the temperature effect being the same for this as for the $\gamma$-ray blackening. R. C. F.

**2560. Sensitisation and Hypersensitisation of Infra-Red-Sensitive Layers. R. Mecke and A. Zobel.** *Zeits. f. wiss. Phot.* 36. *pp.* 59–68, *March,* 1937.—The action of a number of hypersensitising baths, on Agfa infra-red plates (850 and 950), is described. Borax or $Na_2CO_3$ in 50 % MeOH gives some hypersensitising together with a gain in contrast, while $NH_3$ either alone or in combination with either of the above gives much more hypersensitising but some loss in contrast. When the plates are colour-sensitised by bathing, maximum hypersensitisation occurs at a given value of $NH_3$ concentration (6–8 %) but no such maximum is found when hypersensitising ready-dyed plates. The degree of hypersensitisation is independent of bathing time (2 sec.–30 min.) and, from 5°–25° C. of temperature. L. V. C.

**2561. Infra-Red Photography Beyond 10,000 Å. Part II. W. Dieterle and O. Riester.** *Zeits. f. wiss. Phot.* 36. *pp.* 68–72, *March,* 1937.—A synthesis of benzthio-nonacarbocyanine ethiodide is described. This dyestuff gives a sensitising maximum at 9200 Å and various of its derivatives containing substituents in the benzene rings at 9260, 9280 and 9500 Å. These dyes contain no substituents in the polymethine chain and, as previously foreshadowed [see Abstract 4972 (1935)], are more powerful sensitisers than those containing substituted oxy-acyl groups in the polymethine chain. They are employed in the " Agfa 950 " plate. L. V. C.

**2562. Latent Image. Johanna Lauda.** *Akad. Wiss. Wien, Ber.* 145. 2*a*. 9–10. *pp.* 707–723, 1936.—Examines the variations of the latent image for long intervals of time between exposure and development, the dependence of these variations on the energy of the active radiation (light, X- and α-rays), the method of storing (normal air pressures and temperatures, vacuum, ice and moist air), and the influence of desensitisers being dealt with. The results obtained show that after exposure an immediate increase in blackening is followed by a definite reduction below the value obtained by development directly after exposure. The percentage reduction increases with increasing radiation energy, with smaller intensity of blackening, and with the presence of a desensitiser, but decreases with reduction of $O_2$, humidity of the air, temperature reduction and prolongation of development time. R. C. F.

**2563. Latent Image and Print-Out Effect of Photographic Emulsions. A. van Kreveld and H. J. Jurriëns.** *Physica*, 4. *pp.* 285–296, *April*, 1937. *In English.*—Describes the results of an optical investigation of the latent image, using the method described elsewhere [see Abstract 2536 (1937)]. This method enables the latent image to be studied down to the range of normal exposures, the results showing that the latent image and the print-out effect are due to the same process and only differ quantitatively. That the latent image consists of Ag is corroborated, but spectral absorption-measurements show that there is a considerable difference between the latent image in photographic emulsions and the Ag image in AgBr crystals previously used to study latent images. For solarisation the regression theory is shown to be unsound and an " auto-Becquerel " effect is described. R. C. F.

**2564. Berthon-Siemens Colour Films. E. Gretener.** *Zeits. f. techn. Physik*, 18. 4. *pp.* 90–98, 1937.—Deals with the physical and technical aspects of the Berthon-Siemens colour film processes. After briefly discussing colour distortion and 3-colour processes, the lenticular film method is described, considering the fundamental principles of this type of colour film, objective lens systems, photographic representation of the colour components, the copying problem and projection. Finally, regulation of the colours is briefly dealt with. R. C. F.

***2565. Resolvometer. F. Burmistrow.** *Techn. Phys., U.S.S.R.* 3. 12. *pp.* 1079–1089, 1936. *In English.*—Describes an instrument designed to determine the resolving power of negative or negative positive photographic materials, and positive sensitive layers used for sound registration, copying by projection and reproduction with an optical system. The instrument consists of a copying-reproducing system and the test-object holder and illuminating system joined together by two cones and a cylinder screwed together to form a rigid metallic pipe. Details of the adjustment of the instrument are given and the method of determination of the resolving power of photo-layers described in detail. R. C. F.

***2566. Philora Sodium Lamp and its Importance to Photography. J. A. M. van Liempt.** *Philips Techn. Rev.* 2. *pp.* 24–48, *Jan.*, 1937.—In photographs taken with Na light illumination the relative brightnesses of coloured objects are rendered very well. The reproduction becomes almost perfect if the Na light is mixed with a suitable quantity of incandescent or mercury light. Furthermore, Na light offers unexpected advantages for the illumination of dark rooms. AUTHOR.

***2567. Flash Time Characteristics of Indirectly Ignited Photographic Flash Lamps. J. A. M. van Liempt and J. A. de Vriend.** *Physica,* 4. *pp.* 353–360, *May,* 1937. *In English.*—The flash time characteristics of indirectly ignited photographic flash lamps are given and conclusions are drawn in relation to practical use, especially with synchronisers. AUTHORS.

***2568. Cameras with Coupled Photoelectric Light Meters.** *Phot. Indust.* 35. *pp.* 486–490, *April* 28, 1937.—Describes two arrangements, one using two movable pointers and the other using one movable pointer and a fixed position, whereby photoelectric light meters can be satisfactorily coupled to the diaphragm of the objective lens system. Details of the mechanical method of coupling the diaphragm to one of the two movable pointers is also briefly dealt with. R. C. F.

**2569. Theory of Weigert Effect. S. Nikitine.** *Comptes Rendus,* 204. *pp.* 973–975, *March* 22, 1937.—An attempt is made to develop an explanation of the Weigert effect in terms of the probability of transition of the molecules from the normal to an excited state. C. B. A.

*See also* Abstracts 2356, 2473, 2635.

## PHOTOMETRY.

***2570. Flicker Photometry. R. Sewig.** *A.T.M. No.* 70. *T*48, *April,* 1937.—After a brief discussion of the basis of flicker photometry the principal heads of this type are described and illustrated. These are the Krüss, Bechstein and Guild photometers. The influence of field brightness and field size on the accuracy obtainable is mentioned. J. W. T. W.

*** 2571. Photoelectric Illumination Photometers.** *Am. Illum. Eng. Soc., Trans.* 32. *pp.* 379–418; *Disc.,* 419–420, *April,* 1937.—This is the report of a special committee on the use of rectifier photo-cells for portable illumination photometry. The name adopted in the report for this type of cell is "barrier-layer cell." The various sections of the report deal at some length with (*a*) the effect of spectral composition of the light reaching the cell, (*b*) the effect of deviations from the cosine law of illumination, (*c*) other sources of error, including effect of ambient temperature, effect of humidity, lack of linearity of the illumination/response curve, reversible and irreversible fatigue, (*d*) recommendations regarding the design and use of photometers of this type and (*e*) a description of a test box for calibrating photometers. The recommendations are (1) that all photoelectric portable illumination photometers should be calibrated for the light given by a tungsten-filament lamp operating at a colour temperature of 2700° K., (2) that multiplying factors should be given for the four types of discharge lamp in common use and for daylight (I.C.I. illuminant "C"), (3) that when measuring illumination from a single source the cell should be tilted so as to be normal to the incident light, the illumination of any (*e.g.* a horizontal) surface being then calculated by the cosine law, and (4) that manufacturers should reduce as far as possible the error due to departure from the cosine law, by the adoption of some method of correction, and that they should reduce the effects of fatigue and pay attention to securing better electrical contact between the upper sputtered layer and the external circuit. J. W. T. W.

* **2572. Gas-Discharge Tubes Emitting Coloured or White Light and their Photometry. M. Laporte.** *R.G.E.* 41. *pp.* 483–494, *April* 17, 1937.—The author reviews the different methods which are being used to obtain discharge tubes emitting white light, with special reference to the condensed discharge method. In this method a discharge tube in series with a thyratron is connected across the plates of a condenser in parallel with the secondary of a transformer. Once in each cycle of the supply current a very brief ($10^{-5}$ sec.) but very intense discharge (current density of $10^3$ A/cm.) is passed through the tube and the spark spectrum of the contained gas (Xe) is emitted together with an intense continuous spectrum. The resultant colour is described as a " better white than that of the carbon arc." In a second part of the paper, the photometry of discharge tubes is discussed and a physical photometer is described in which a spectrum of the source is passed through a diaphragm of such a shape that the height of the spectrum at each wave-length is reduced to a value proportional to the luminosity of that wave-length. The light of all wave-lengths after passing through the diaphragm is concentrated on to a thermopile. Tests of the accuracy and precision of this direct-reading photometer are described. W. S. S.

**2573. Effect of Luminous Intensity on Sensitivity of Photoelectric Counters. J. Roulleau.** *Comptes Rendus,* 204. *pp.* 1191–1192, *April* 19, 1937.—The author is concerned with the relation between the number of discharges per min. given by a photoelectric light counter and the intensity of the light. The total emission from a hydrogen tube was measured for different currents with a thermopile and light from the same tube was passed through a monochromator and the nearly monochromatic radiation issuing from the exit slit was allowed to fall on the photo-cell. In this way it was found that as the luminous intensity increased the ratio of the discharges per min. due to the light to the luminous intensity steadily decreased, this effect being more marked the greater the sensitivity of the cell. W. S. S.

* **2574. Photoelectric Spectrophotometry. T. R. Hogness, F. P. Zscheile, Jr. and A. E. Sidwell.** *J. Phys. Chem.* 41. *pp.* 379–415, *March,* 1937.—Full constructional details are given of a non-photographic photoelectric spectrophotometer suitable for quantitative analytical chemical work. Current and voltage sensitivities have been much improved so that narrower slits are now usable and the speed is much greater than before. Furthermore, the absorption cells are now placed behind the second slit of the monochromator so that the intensity of radiation to which the solutions are exposed is much reduced and photochemical decomposition is no longer a disturbing factor. Details are also given of the calibration and applications of the instrument. A. H.

*See also* Abstracts 2362, 2493.

## POLARISATION.

**2575. Influence of Water and of Deuterium Oxide on Optical Rotation. C. Buchanan.** *Chem. Soc., J. pp.* 581–584, *April,* 1937.—The optical rotation of solutions in $H_2O$ and in $D_2O$ (99 %) of (I) methyl *d*-tartrate, (II) methyl *d*-dimethoxysuccinate, and (III) *l*-nicotine, has been examined for two colours of light and at different temperatures, with the following results: (I) Concentration, $p = 25$; specific rotation about 3 % lower in $D_2O$. (II) Concentration, $p = 20$; specifical rotations identical. (III) Concentration, $p = 10$; specific rotation about 1 % higher in $D_2O$. Nicotine was found to be less soluble in $D_2O$ than in water at 60·5°. AUTHOR.

*See also* Abstracts 2326, 2352, 2545, 2780.

## RADIATION, EMISSION.

**2576. Radiation between Two Coaxial Radiating Cylinders. H. Buckley.** *Phys. Soc., Proc.* 49. *pp.* 225–229, *May* 1, 1937.—The paper discusses the problem of the radiation transfer from an electrically heated inner cylinder to a surrounding coaxial cylinder. Expressions are derived for the total radiation, emitted and reflected, from unit area of each of the cylindrical surfaces between which multiple reflection of radiation occurs. It is then shown how, from these expressions, the relation of the true temperatures to the apparent temperatures of the surfaces (obtained by means of a total-radiation pyrometer or by means of a disappearing-filament optical pyrometer) can be determined. AUTHOR.

**2577. Cosmic Rays in Stratosphere. S. N. Vernov.** *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 14. 5. *pp.* 263–266, 1937. *In English.*—Results are given for the variation of intensity with height, up to 22 km., at 35° N. magnetic latitude; they were obtained with single counters in an unmanned balloon, the results being transmitted to earth by radio. The increase of intensity with height was not so rapid as in a trial flight at Leningrad. The experimental errors do not allow a definite difference in intensity at the two places to be discerned at heights below 9 km., but at 12 km. the intensity at 35° N. is only 2/5 that at Leningrad. The results are discussed and it is argued that the rate of increase of intensity with height at 35° N. lends probability to the assumption of the existence of a photon component in cosmic radiation. D. H. F.

**2578. Cosmic Radiation in a Mine. J. Barnóthy and M. Forró.** *Zeits. f. Physik,* 104. 11–12. *pp.* 744–761, 1937.—With a three-fold coincidence arrangement with narrow field of view measurements were made at a water-equivalent depth of 732 m. with different angles of inclination to the axis plane. The results yielded a penetration capacity of the cosmic-ray particles of 1500 m. water-equivalent with a vertical intensity of $2 \cdot 5 \times 10^{-6}$ coincid./cm$^2$. deg$^2$. hr. The coincidences are produced by shower particles which probably are liberated by neutrinos. J. J. S.

**2579. Latitude Effect of Penetrating Radiation. B. Gross.** *Zeits. f. Physik,* 105. 5–6. *pp.* 334–340, 1937.—The theory that the latitude effect at sea-level may be explained on the supposition of an almost homogeneous component of the penetrating radiation is found to account for various established phenomena such as the relation between latitude effect and absorption curve, and the variation of latitude effect with altitude. The energy distribution of the penetrating components as calculated from the latitude effect is in approximate agreement with that found experimentally. F. C. C.

**2580. Diurnal Variation in Cosmic-Ray Intensity. S. E. Forbush.** *Terr. Mag.* 42. *pp.* 1–16, *March,* 1937.—Cosmic-ray data from precision cosmic-ray meter records, obtained at Cheltenham, Maryland, for 273 complete days during April, 1935 to Oct., 1936 are subjected to rigorous statistical analysis. The results indicate that the real barometric coefficient does not change from hour to hour or from month to month. It is shown that the barometric coefficient obtained at this station is in good agreement with certain results obtained from altitude-intensity curves. It is furthermore shown, in two independent ways, that there is no indication of any external air-temperature effect upon the recorded intensity. Finally, the data have been subjected to modern statistical methods which provide an objective measure for the probability that the observed diurnal-variation is real. The results indicate, for the period covered by this analysis, a physically significant 24-hr. wave in apparent cosmic-ray intensity with an amplitude of 0·17 % of the total intensity having its maximum at about 11ʰ, 75° west meridian mean time. AUTHOR.

**2581. Cosmic-Ray Secondary Particles from Pb. J. Itoh.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 271–285, *March*, 1937. *In English.* —Counter experiments are described from which it is concluded that the secondary particles produced by non-ionising secondary cosmic radiations in Pb are composed of soft and very hard components. The former may be identified with the soft shower particles observed in the usual counter experiments, and the latter may be related to the second maximum of the Rossi curve. Measurement of the frequency of production of the secondary particles from Pb plates in the vertical direction showed the frequency *v.* thickness curve to be different from that obtained with a triangular arrangement of counters. The difference may be due to a predominance of the soft secondary component in the vertical direction. D. H. F.

**2582. Secondary Particles from the Penetrating Component of Cosmic Radiation. W. H. Pickering.** *Phys. Rev.* 51. *pp.* 628–629, *April* 15, 1937.—Experiments are described that show that some of the coincidences between three Geiger counters in a vertical line separated by a considerable thickness of lead are not due to the passage of a single ionising particle through the three counters but rather to secondary particles released in the lead near the counters. The experiments enable an estimate of the magnitude of this effect to be made. AUTHOR.

**2583. Analysis of Cosmic-Ray Absorption Curves. B. Gross.** *Phys. Zeits.* 38. *pp.* 201–202, *April* 1, 1937.—Calculations are performed on the variation of cosmic-ray intensity with height in the atmosphere, and compared with the recent analysis of absorption curves by Pfotzer [see Abstract 4684 (1936)]. D. H. F.

**2584. Origin of Cosmic Radiation. H. Alfvén.** *Comptes Rendus,* 204. *pp.* 1180–1181, *April* 19, 1937. *Zeits. f. Physik,* 105. 5–6. *pp.* 319–338, 1937.—It is suggested that one of the components of a double star would act as a unipolar inductor, emitting positive particles in one direction and negative particles in an opposite direction. These would constitute rectilinear currents of perhaps $10^{8}$–$10^{10}$ A, whose magnetic field would be appreciable over enormous distances. A consequence of this is that the cosmic particles received by the earth must have originated within a sphere having a radius of curvature of a few hundred light-years only. It is pointed out that the cosmic-ray intensity so produced could be of the right order, and would be independent of sidereal time. D. H. F.

**2585. Terrestrial Origin for Cosmic Rays. M. C. Holmes.** *Frank. Inst., J.* 223. *pp.* 495–500, *April,* 1937.—It is pointed out that it follows from Debye's picture of the polar water molecule that there is a charge of negative electricity all over the surface of the earth. This will cause a separation of the positive and negative ions produced in the atmosphere, and it is shown that this, in combination with the effect of the horizontal pole-ward air currents, can account for the cosmic-ray phenomena. The suggestion is shown to be qualitatively consistent with the latitude effect and it is shown that the mechanism provides sufficient energy. D. H. F.

**2586. Effect of Galactic Rotation Upon the Intensity of Cosmic Radiation. W. F. G. Swann.** *Phys. Rev.* 51. *pp.* 718–720, *May* 1, 1937.—The formulæ obtained by Compton and Getting [see Abstracts 3010 (1935) and 645 (1937)] for neutral particles are deduced by processes closely analogous to the processes used by those authors. It is shown, however, that the extension to charged particles may be formulated in a manner which makes use of the modified form of Liouville's dynamical theorem which has been found successful in other cosmic-ray problems, and the result is that the intensity at any point on the earth's surface is expressed in simple manner in terms of the direction of the orbit of the charged particle when traced back to infinity. Attention is called to the modification demanded by the theory of relativity in the intuitive picture of the phenomenon. The simple naïve picture of what happens visions a stream of charged particles with the earth moving, for example, towards them. In this picture there is the alteration of relative velocity produced by the earth's motion, which is responsible for the change of intensity. The theory of relativity demands, however, a picture in which there is no alteration of relative velocity by the earth's motion, but where there is a change of particle density which conspires to produce a result the equivalent of that produced by change of relative velocity in the simple picture. AUTHOR.

**2587. Production of Monochromatic Light by Optical Resonance. L. Dunoyer.** *Rev. d'Optique,* 15. *pp.* 361–374, *Nov.,* 1936.—In addition to their natural width spectral lines are broadened by the Doppler effect, interatomic collisions, absorption, the Stark effect, the presence of isotopes (when the spectroscopic resolution is insufficient for resolution of the resulting fine structure) and molecular diffusion. These effects are discussed and applied to the usual spectroscopic sources. In the discharge tube the broadening is almost all due to the Doppler effect. The breadth of lines in resonance from a volume of vapour is entirely due to the Doppler effect, but in the resonance from an atomic ray this effect is eliminated and the width is not at present measurable. The superficial resonance of Na vapour gives a width less than that produced by the Doppler effect, probably due to the atoms being adsorbed on the walls. The chief practical difficulty is the production of an exciting radiation of suitable strength and showing no self reversal. H. G. C.

*See also* Abstracts 2440, 2566, 2572, 2830, 2860.

## RADIATION, GENERAL THEORY.

**2588. Moments of Impulsion in de Broglie's Theory of the Photon. J. Géhéniau.** *Comptes Rendus,* 204. *pp.* 665–668, *March* 1, 1937.—Commencement of a mathematical study of the subject which the author proposes to develop further in a future paper. The formulæ reached show that the physical magnitudes of the theory of the photon depend explicitly on the electromagnetic potentials. J. J. S.

**2589. Relations Between the Second and Higher Order Processes in the Neutrino-Electron Field Theory. M. H. Johnson, Jr., and H. Primakoff.** *Phys. Rev.* 51. *pp.* 612–619, *April* 15, 1937.—Without specialising the nature of the interaction between the proton, neutron, electron and neutrino fields both the magnitude and range of the proton-neutron force are deduced. A similar treatment of the proton-proton force shows that the range of this force is certainly less than the range of the proton-neutron force and that there is a simple relationship between the magnitude of this force and the range and magnitude of the proton-neutron force. This relationship together with the relationship between the singlet like and unlike particle forces, deduced from proton-proton and proton-neutron scattering, leads to a value for the range of the proton-neutron force which cannot exceed $0 \cdot 4 \times 10^{-13}$ cm. A treatment of an *n*-tuple process in which a fast proton (or neutron) produces cosmic-ray showers, is also given, and it is found that the same condition on the range is necessary for this process to have an appreciable probability. AUTHORS.

**2590. Neutrino Theory of Light. Parts II and III. P. Jordan.** *Zeits. f. Physik.* 105. 1–2. *pp.* 114–121, *and* 105. 3–4. *pp.* 229–231, 1937.—In Part II the author considers the relationship between the wave amplitudes; *i.e.*, the amplitude of the neutrino field and V(x) that of the light field. While in the first paper the construction of the Fourier coefficients for the light field was obtained from those of the neutrino field, here the reverse is the case, and the neutrino wave amplitudes are obtained from those of the light field. The relationship of the new results to the theory of $\beta$-decay is discussed. A criticism of the author's earlier work on this subject by Fock [see Abstract 650 (1937) and following Abstract] is dealt with and shown to be incorrect. In Part III a correction is made which, however, leaves the results of the earlier paper unaltered. A further relation concerning the wave amplitude of the neutrino field is given. [For Part I see Abstract 5126 (1936).] G. O. B.

**2591. Neutrino Theory of Light. V. Fock.** *Phys. Zeits. d. Sowjetunion,* 11. 1. *pp.* 1–8, 1937. *In German.*—The neutrino theory of light proposed by Jordan [see preceding Abstract] is criticised on the ground that the operators which Jordan regards as the quantised amplitudes of the light field fail to satisfy the commutation laws of the Bose statistics. It is suggested further that no theory which assumes a relationship between the quantised wave-functions of the neutrino field and of the light field is likely to be true. [See following Abstract.]. W. S. S.

**2592. Neutrino Theory of Light. M. H. L. Pryce.** *Zeits. f. Physik,* 105. 1–2. *pp.* 127–132, 1937.—The interaction between a neutrino and an electron is derived from Jordan's neutrino theory of light and from the known interaction between light and matter. The calculations refer to the one-dimensional case. Attention is drawn to certain convergence conditions which are essential to the neutrino theory. Fock's criticism of the neutrino theory [see preceding Abstract] arose, it is suggested, from the implicit assumption of the wrong convergence conditions. W. S. S.

## RADIATION, MECHANICAL EFFECTS.

**2593. Radiation Pressure in Galactic Nebulæ. J. L. Greenstein.** *Astrophys. J.* 85. *pp.* 242–248, *April,* 1937.—The existence of small solid particles with radii approaching the wave-length of light is indicated by the observed interstellar selective absorption. The recent investigations of Struve and his collaborators indicate that particles much larger than the wave-length of light dominate in bright galactic nebulæ. The source of this difference is found in the enormous radiation pressure of the hot stars illuminating the nebulæ. Figures 1–4 in the original show the dependence on spectral type of the sizes of the particles repelled by a star. Further observations should yield information on the frequency function of particle sizes in space. AUTHOR.

*See also* Abstract 2724.

## REFLECTION, REFRACTION AND DISPERSION.

**2594. Optics of Thin Metal Films. H. Wolter.** *Zeits. f. Physik,* 105. 5–6. *pp.* 269–308, 1937.—After a discussion of earlier methods for determining the optical constants of thin metal films, a simple way of calculating the important magnitudes *n, k* from intensity measurements is described. The validity of the approximate formulæ developed for this purpose is investigated, and a simple proof of Maxwell's theory is given. A criterion of the value of intensity measurements on thin metal films is deduced, and this affords a simple explanation of the failure of the methods of Murman and Véeneman when applied to very thin films. Finally, an optical method for determining film thickness is suggested and tested by means of examples. A. G. Q.

**2595. Maxwell Effect in Organic Liquids. A. B. Rao.** *Indian Acad. Sci., Proc.* 5*A. pp.* 124–127, *Feb.,* 1937.—Out of four aliphatic liquids studied, the two alcohols show a Maxwell constant which is in good agreement with that predicted on the basis of Raman-Krishnan theory. The observed values for the two acids are much larger than the calculated values. Molecular association is suggested as the explanation for this divergence. Again, aniline shows good agreement whereas the calculated value for nitrobenzene is low when compared with the observed one. [See Abstracts 3190 and 3639 (1936).] J. K.

**2596. Optical Properties and Polymorphism of Paraffins. C. D. West.** *Am. Chem. Soc., J.* 59. *pp.* 742–743, *April,* 1937.—The simple procedure is described for measuring, by means of a total reflection refractometer equipped with a cap polariser, the refractive indices of materials which solidify to form transparent uniaxial films. The dimorphism of solid dicetyl is demonstrated by refractometric measurements, and approximate values of its optical constants are given over a range of temperatures. AUTHOR.

**2597. Refraction and Dispersion of Heavy Methane ($CD_4$). T. Larsén.** *Zeits. f. Physik,* 105. 3–4. *pp.* 164–167, 1937.—The refraction and dispersion of $CD_4$ between 5680 and 2300 Å are experimentally determined. Compared with $CH_4$ the total amount of refraction is decreased and the dispersion curve is somewhat flatter. The effects are analogous to those found for $D_2$ and $D_2O$ vapour [see Abstracts 3188 and 3189 (1936)]. J. E. K.

**2598. Anomalous Dispersion of Excited Argon. K. Schön.** *Ann. d. Physik,* 28. 7. *pp.* 649–666, *April,* 1937.—In excited A, the ($Is_2$–$2p_k$) lines, which mostly lie in the infra-red, show anomalous dispersion. The "hook" method was employed to measure this, a Jamin interferometer being used in combination with a stigmatic grating spectrograph. The accuracy claimed is only about 20%, but this suffices to show the analogy with the results of Ladenburg and his co-workers for Ne. F. S.

**2599. Statistical Methods in Manufacture of Spectacle Glass. C. E. Gould and W. M. Hampton.** *Soc. Glass Technol., J.* 21. *pp.* 235–246, *April*, 1937.—A brief description is given of the process of manufacture of glasses for spectacles. The problem of separating the effect on quality of the many variables was approached by statistical methods. Selected samples were marked for seed and veins, and the results recorded over several years. Correlation coefficients have been calculated for various associations of the data and attempts have been made to connect such factors with the conditions of manufacture. Variation in refractive index over many meltings is also discussed. AUTHORS.

***2600. Ray-Displacement Refractometer. K. Prosad and R. P. Gupta.** *Indian Journ. Phys.* 11. *pp.* 13–19, *Feb.*, 1937.—The paper describes a very convenient and accurate type of refractometer, which can be easily built up. The probable error of the mean value of $\mu$ determined by this apparatus is found to be $\pm 0\cdot0002$ and possesses a high degree of reproducibility. It is specially suited for the determination of $\mu$ of thin transparent plates obtainable in small sizes, but can also be used for liquids. AUTHORS.

*See also* Abstracts 2498, 2553, 2667.

## SPECTROSCOPY.

**2601. Spectra of Phosphorus. Part II. P III, P IV, P V. H. A. Robinson.** *Phys. Rev.* 51. *pp.* 726–735, *May* 1, 1937.—Data taken from spectrograms using a vacuum spark containing red P, supplemented by spectrograms previously described, have enabled a complete revision and extension of the spectra of P III, P IV, and P V. Certain quintet terms in P II have also been located. In P III 19 new terms have been found which classify 59 lines. Six of these terms replace previous terms which have proved erroneous. The ionisation potential is found to be $30\cdot012 \pm 0\cdot003$ V. Tentative intercombinations between the doublet and quarter systems are given. In P IV 23 new terms have been found which classify 51 lines. Several intercombinations have been located between the singlet and triplet systems. The various series are badly perturbed. The ionisation potential is $51\cdot106 \pm 0\cdot103$ V. In P V 14 new terms have been located which classify 20 lines. The series is very regular and gives an ionisation potential of $64\cdot698 \pm 0\cdot003$ V. The previous data have been entirely revised in view of new measurements and complete term tables as well as complete lists of lines now classified in the Schumann region are given. [For Part I see Abstract 1652 (1936).] AUTHOR.

**2602. Guides to the Analysis of Unresolved Groups of Spectral Lines. F. Paschen.** *Preuss. Akad. Wiss, Berlin, Ber. Nos.* 28–29. *pp.* 402–424, 1936.—In dealing with the hyperfine structure of spectral lines the problem is frequently met of analysing a structure which contains groups of unresolved or superimposed components. An indication is given of the information which may be gleaned from the separations between the unresolved groups and from the relative intensities of groups and individual components. By way of example the separations and intensities of components are worked out and presented in tabular form for an element having a nuclear moment $i = 9/2$ for all possible values of $j$ and of the $i$-$j$ coupling factor A. Certain generally applicable rules for analysis are deduced from the special case; these rules are also applicable to the analysis of the ordinary fine structure of spectral lines. J. E. K.

**2603. New Terms in the Spark Spectrum of Argon. T. L. de Bruin.** *K. Akad. Amsterdam, Proc.* 40. 4. *pp.* 340–348, 1937.—The analysis of the spectrum of A II is continued and extended to A III. Details are now given of certain A II terms which were lacking before, and of certain A III terms combining with the $^2p$ term. A. H.

**2604. Analysis of the Hydrogen Spectrum. W. M. Venable.** *J.O.S.A.* 27. *pp.* 155–158, *April*, 1937.—The hypothesis is put forward that the entire hydrogen spectrum (*i.e.*, atomic and molecular) can be accounted for numerically with great accuracy by the compounding of simple differences between a comparatively small number of levels forming one single mathematical system. A. H.

**2605. Hyperfine Structure of the Sodium D Lines. K. W. Meissner and K. F. Luft.** *Ann. d. Physik*, 28. 7. *pp.* 667–672, *April*, 1937.—Extremely sharp D-lines are obtained by exciting a Na atomic beam by electron collisions which permit investigation of their hyperfine structure with a Fabry-Perot interferometer having étalon separations up to 13 cm. In this manner the two pairs of components resulting from the splitting of the $^2P_{1/2}$ term are observed and measured. The separations of the $^2S_{1/2}$ and $^2P_{1/2}$ terms are measured as $\Delta\nu = 0{\cdot}0594$ cm$^{-1}$, and $\Delta\nu = 0{\cdot}0058$ cm$^{-1}$, respectively with a maximum error of $0{\cdot}0003$ cm$^{-1}$. From these separations the magnetic moment of the Na nucleus is calculated to be 2·08 and 1·96 nuclear magnetons respectively. J. E. K.

**2606. Magnetic Moment of the Scandium Nucleus. H. Kopfermann and H. Wittke.** *Zeits. f. Physik*, 105. 1–2. *pp.* 16–20, 1397.—From hyperfine structure analysis of the $4s\,^2S_{1/2}$ term of Sc III the magnetic moment of the scandium nucleus is calculated to be 4·8 nuclear magnetons and to be of positive sign. J. E. K.

**2607. Mechanical Nuclear Moment of Caesium from the Inverse Zeeman Effect of the Hyperfine Structure. T. Fölsche.** *Zeits. f. Physik*, 105. 3–4. *pp.* 133–163, 1937.—The Zeeman effect of the hyperfine structure of the Cs resonance lines 8943 and 8521 Å is investigated for medium-strong fields at which the Paschen-Back effect is already well in evidence. The observed line structures are in good agreement with theoretical expectation based on a nuclear moment $i = 7/2$; the agreement extends to the components whose presence in strong fields is "forbidden." Some measurements of the hyperfine structure of 8943 Å in absorption are reported. The quantum-mechanical calculation of the Zeeman effect of the hyperfine structure for arbitrary field strengths is presented in an appendix to the paper. J. E. K.

**2608. Nuclear Structure and Quadrupole Moment of $^{187}_{75}$Re and $^{185}_{75}$Re. H. Schüler and H. Korsching.** *Zeits. f. Physik*, 105. 3–4. *pp.* 168–174, 1937.—This paper comprises two parts. In the first part it is shown from measurements of Tl, Re and Cu that the addition of two neutrons to a nucleus having an odd number of protons and an even number of neutrons produces a minimal change in the magnetic moment for which the relation $\mu_{u+2}/\mu_u = M_{u+2}/M_u$ holds goods ($u$ is the mass number of the lighter isotope). The heavy isotope has the larger magnetic moment. In the second part of the paper results of measurements of the hyperfine structure of Re are reported. The Re I lines 4889 and 5275 Å have an isotope displacement which permits separate determination of the magnetic moments of $^{187}$Re and $^{185}$Re. The ratio of the magnetic moments is calculated as $\mu 187/\mu 185 = 1{\cdot}0107$ from 4889 Å and 1·0114 from 5275 Å. Assuming Russell-Saunders coupling the quadrupole moment is found to be $q = + 2 \cdot 6 \times 10^{-24}$. The quadrupole moment decreases a few per cent. on addition of two neutrons to the nucleus, a trend which is also shown in the case of Ga and Eu. J. E. K.

**2609. Line-Spectra of Atoms. Part II. G. Joos and K. H. Hellwege.** *Die Physik*, 5. 2. *pp.* 33–41, 1937.—A *résumé* of present knowledge. It deals with light-sources, term-analysis, questions of intensity and hyperfine-structure, Zeeman effect, Stark effect and the effects of pressure. [For Part I see Abstract 4096 (1933).] F. S.

**2610. $^3P^0 - {}^3P$ Combination in the Arc Spectrum of Cerium. S. Frisch.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 14. 5. *pp.* 287–288, 1937. *In English.*—A group of five Ce lines strictly symmetrical (on the frequency scale) about the middle line has been observed. Such symmetrical groups are well known in the spectra of Al II, Sr I, etc., and result from a combination of two $^3$P-terms with identical separations, one being even and the other odd. It is suggested that the five Ce I lines are due to such a combination of two $^3$P-terms with intervals $\Delta\nu_1 = 347 \cdot 04$ cm. and $\Delta\nu_2 = 727 \cdot 56$, the interval ratio $\Delta\nu_2/\Delta\nu_1 = 2 \cdot 095$. A. H.

**2611. Effect of Configuration Interaction on the Low Terms of the Spectra of Oxygen. D. R. Hartree and Bertha Swirles.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 240–249, *April*, 1937.—In earlier work it has been assumed that matrix elements of the Hamiltonian involving two different configurations are negligible, so that each state can be described by a single configuration, whereas these matrix elements are probably appreciable and a better approximation is obtained by the use of a wave function corresponding to superposition of more than one configuration, i.e., configuration interaction. This idea is applied quantitatively to the lowest states of the oxygen atom in various states of ionisation. The results show that the magnitude of the effect is sufficient to account for the differences between observed inter-multiplet separations and those calculated on the assumption that each state could adequately be described by a single configuration. A. H.

**2612. Line Strengths in Neon I. C. W. Ufford.** *Astrophys. J.* 85. *pp.* 249–250, *April*, 1937.—The line strengths for the transition array $2p^5 4p - 2p^5 4s$ of Ne I are calculated in intermediate coupling, including the electrostatic and spin-orbit interactions. [See also Abstract 1638 (1935).] AUTHOR.

**2613. Nonadiabatic Processes in Inhomogeneous Fields. J. Schwinger.** *Phys. Rev.* 51. *pp.* 648–651, *April* 15, 1937.—The problem of calculating nonadiabatic transition probabilities is considered. It is shown that the general Güttinger equations [see Abstract 3237 (1931)] are incorrect and lead to erroneous results in any case other than that of the rotating magnetic field, which he considered. The corrected equations are applied in the calculation of the transition probabilities between the various magnetic states of a field precessing with constant angular velocity. AUTHOR.

**2614. Regularity along a Series in the Variation of the Action Cross-Section with Energy Discrepancy in Impacts of the Second Kind. O. S. Duffendack and W. H. Gran.** *Phys. Rev.* 51. *pp.* 804–809, *May* 15, 1937.—The enhancement of the intensities of lines in the spark spectrum of lead when excited by impacts of the second kind with neon ions relative to their intensities in electron impact excitation was measured. When the values of the enhancements are plotted against the energy discrepancies of the spectral terms in which the lines originate, smooth characteristic curves can be drawn through the points belonging to the same spectral series. The curves for different series, while similar in form, exhibit marked differences in details. Measurements were made on terms of negative as well as on terms of positive energy discrepancy. Maxima appear in the curves on the side of positive energy discrepancy, *i.e.*, on the side where the energy values of the terms are less than the ionisation potential of neon. The form of the curves beyond the maxima indicates that they may be of the form $q = \mathrm{A}/\sigma^x$ where the values of both A and $x$ vary with the particular series. The terms of the D series are most strongly enhanced. A calculation fixes the cross-section for these collisions at approximately $15 \times 10^{-11}$ cm$^2$. AUTHORS.

**2615. Pressure Effect in Bands of Several Dipole Molecules. S. D. Cornell.** *Phys. Rev.* 51. *pp.* 739–744, *May* 1, 1937.—Several photographic infra-red bands of $H_2O$, HCN, and $NH_3$, have been investigated for line broadening due to increased pressure of the vapours themselves. The half-widths at 1 atmos. have been found, and the excess broadening per atmos. calculated in each case. Comparison with simple dipole interaction theory has been made. Conformity is found for one $H_2O$ band, compared with HCN. Lack of conformity for another $H_2O$ band, and for two $NH_3$ bands, is discussed. For HCN a variation of half-width with $J$ is found, in accord with theoretical considerations of a qualitative nature, leading to broader lines near the thermal maximum of the rotational velocity distribution. Effect of change in slit width on the observed line width and rate of broadening, and the consequent precautions necessary, are discussed. AUTHOR.

**2616. Spectrum of TiO in the Region λ8000–12000. K. Wurm and H. J. Meister.** *Zeits. f. Astrophysik*, 13. 3. *pp.* 199–204, 1937.—About 50 band edges not previously observed in the laboratory are found in the spectrum of TiO in the region between λ8000 and 12000. 11 of these bands have been previously observed in stellar spectra by von Bobrovnikoff (λ8000 to 8600, α Herculis) and 8 of them by Merrill (λ8400 to 9000, α Herculis, R Hydræ). 15 of the newly found bands belong to the known red $(\mathrm{A})^3\Sigma - {}^3\Pi$ system. The remainder of the bands including those measured by Merrill cannot be arranged in this system and probably represent a new system extending from λ8400 to at least λ12000. The structure of the individual bands is similar to that of the first red system and indicates a $\Sigma - \Pi$ transition. Most of the bands are of red gradation. Strong bands of the new system lie at λ8440, 8860, 9725, 10125 and 11030. J. E. K.

**2617. Red Band Spectrum of NiH. A. Heimer.** *Zeits. f. Physik*, 105. 1–2. *pp.* 56–72, 1937.—The band spectrum of NiH, produced by thermal excitation at 2400° C, is photographed in the first order of a concave grating giving a dispersion of 1·95 Å per mm. The present paper deals only with bands belonging to the system in the red. Analysis of newly observed bands raises the number of known nuclear vibrational levels to 4 in in the initial state and to 2 in the final state. Term differences, doublet separations and perturbations are discussed and the isotope effect is investigated for all the bands. Term values and band constants are given. L. A. W.

**2618. Spectrum of Thallium Fluoride. H. G. Howell.** *Roy. Soc., Proc.* 160*A*. *pp.* 242–253, *May* 18, 1937.—The spectrum of TlF has been investigated in absorption and also in emission by means of a h.f.

discharge. A doublet and a singlet system of bands have been found in absorption together with three continua all within the region 2000–3100 Å. The doublet system also occurs in emission. It is considered that the doublet system is due to $^30^+ \rightleftarrows {}^1\Sigma^+$ and $^31 \rightleftarrows {}^1\Sigma^+$ transitions and the singlet system to a $^1\Pi \leftarrow {}^1\Sigma^+$ transition. The following constants of these levels have been determined:

| Level | $\nu_e$ | $\omega_e$ | $x_e\omega_e$ |
|---|---|---|---|
| $^1\Pi$ | ~45500 | ~360 | — |
| $^30^+$ | 36869·5 | 360·65 | 12·25 |
| $^31$ | 35180·7 | 439·87 | 8·60 |
| $^1\Sigma^+$ | 0 | 475·00 | 1·89 |

The analysis of the absorption spectrum made by Boizova and Butkow [see Abstract 3741 (1934)] is shown to be incomplete and incorrect. Predissociation occurs in all the band systems and is probably responsible for the band intensities being the same in both emission and absorption. A short discussion on the nature of the unstable levels causing predissociation is given. No sign of the Tl$^{203}$ isotope has been detected. AUTHOR.

**2619. Investigations in the Infra-Red. Part II. Absorption Spectrum of Boric Acid. M. K. Sen.** *Indian Journ. Phys.* 11. *pp.* 9–12, *Feb.*, 1937.—The infra-red spectrum of boric acid, $H_3BO_3$ is investigated between the region 5$\mu$ to 15$\mu$. As many as eight absorption bands are observed. Three of them correspond to the vibrational frequencies associated with the $BO_3$ radical while the others are due to the molecule $B(OH)_3$. [For Part I see Abstract 4265 (1935)]. AUTHOR.

**2620. Far Infra-Red Bands of Borates and Oxides. M. Parodi.** *Comptes Rendus*, 204. *pp.* 1111–1112, *April* 12, 1937.—Three characteristic bands appear in the reflection and absorption spectra of the borates of Ca, K, Mn, Cu, Pb. The ascertained data for borates are compared with similar data for the corresponding oxides. W. R. A.

**2621. OH- Vibration Spectrum in the Photographic Infra-Red. S. Mizushima, Y. Uehara and Y. Morino.** *Chem. Soc., Japan, Bull.* 12. *pp.* 132–135, *March*, 1937. *In English.*—Previous dipole measurements on ortho-substituted phenols were in accordance with Pauling's theory of quantum mechanical resonance, which was originally put forward for the interpretation of the infra-red absorption spectra observed by Wulf and Liddel. The overtones of the OH- vibration have now been studied as absorption spectra in the photographic infra-red in order to obtain further experimental evidence for the above conclusion as well as to complete former work on the vibration spectra of alcohols [see Abstract 722 (1937)]. The measurements were carried out with a glass spectrograph of dispersion 74 Å per mm. at 9000 Å, Fe and Ba lines being used as reference. The results are consistent with the interpretation of these spectra as due to one normal mode of vibration of the molecule which is essentially the vibration of the H atom of the -OH radical relative to the rest of the molecule. H. H. Ho.

**2622. Infra-Red OH Bands of Alcohols and Polyalcohols. R. Freymann.** *Comptes Rendus*, 204. *pp.* 1063–1065, *April* 5, 1937.—Evidence is submitted for the existence of two infra-red absorption bands of the radical OH, having fundamentals of wave-length 2·75 and 2·98$\mu$ respectively. The former of these two bands is attributed to molecules in a free state as in the vapour, the latter to molecules constrained as in the solid. W. S. S.

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**2623. OH and CH= Bands of Phenol and its Derivatives between 6000 and 9500 Å. P. Barchewitz.** *Comptes Rendus,* 204. *pp.* 1184–1186, *April* 19, 1937.—Phenol and certain of its derivatives show two OH bands (about 7490 and 7650 Å), their wave-lengths depending on the nature and position in relation to the OH group of the substituted groups. Except for o-chlorophenol the shorter wave-length band is the stronger. The longer wave-length band probably does not correspond to the OH band at 3$\mu$ in alcohols. With increasing temperature the stronger OH band in phenol increases in intensity and moves to shorter wave-lengths and the weaker diminishes; the CH= band moves to longer wave-lengths.
H. G. C.

**2624. Infra-Red Absorption Spectra of Substituted Benzene Derivatives. J. Lecomte.** *Comptes Rendus,* 204. *pp.* 1186–1189, *April* 19, 1937.—The absorption spectra are measured between 1350 and 500 cm$^{-1}$ of 20 mono- and 100 di-substituted benzenes (o-, m-, and p-) involving the groups CHO, $NH_2$, $OCH_3$, OH, F, $CH_3$, CN, Cl, Br, $NO_2$ and I. The spectra are compared with the Raman spectra and the symmetry of the benzene molecule is discussed with reference to these data. H. G. C.

**2625. Infra-Red Absorption Spectra and Modes of Vibration of Halogen Derivatives of Carbon. G. Emschwiller and J. Lecomte.** *J. de Physique et le Radium,* 8. *pp.* 130–144, *April,* 1937.—An account is given of the infra-red absorption spectra of certain halogen derivatives (chiefly iodo-) of $CH_4$, $C_2H_6$, $C_2H_4$ and $C_2H_2$, between the frequencies 1450 and 525 cm$^{-1}$. By correlation with previous Raman spectra data, the majority of the infra-red absorption maxima have been identified with definite modes of vibration of the molecules studied. Frequencies have been associated with carbon-halogen bonds, and with interactions between C–H and halogen, and the degree has been examined of the influence of these frequencies on the nature of the molecules. It has been found possible to assign without ambiguity the cis- and trans-isomerism of the dichloro- and diiodo-ethylenes. H. H. Ho.

**2626. Infra-Red Spectra and Fundamental Vibration Bands of Diacetylene, Butadiene and Vinylacetylene. E. Bartholomé and J. Karwell.** *Zeits. f. phys. Chem.* 35. *Abt.B.* 6. *pp.* 442–454, 1937.—The spectra of diacetylene ($C_4H_2$), butadiene ($C_4H_4$) and vinylacetylene ($C_4H_6$) are investigated from 3 to 23$\mu$ by a prism spectrograph with rock-salt or sylvine optical parts for the appropriate spectral ranges. An examination of the parallel bands of $C_4H_2$ by a grating spectrometer has convincingly shown that this molecule is linear, and a new classification of the bands is made. The fundamental vibrations of $C_4H_4$ and $C_4H_6$ are also assigned. W. R. A.

**2627. Near Infra-Red Spectra of Organic Substances in the Liquid and Vapour States. A. Naherniac.** *Ann. de Physique,* 7. *pp.* 528–597, *April,* 1937.—An automatic intensity recording spectrograph of high dispersive power is used for comparing the spectra of organic substances containing an OH group over the range 8,600 to 11,600 Å. Bands characteristic of the OH group suffer displacements in passing from one compound to another and are particularly marked in passing from a primary alcohol to the isomeric secondary and tertiary alcohols. Displacements are also brought about in changing from the liquid to the vapour or dissolved states. Abrupt changes are observed at the critical points of the compounds. These effects are attributed to inter- and intramolecular van der Waals' forces resulting from interaction between permanent dipoles or permanent and induced dipoles or electrons moving in different atoms. W. R. A.

**2628. Near Infra-Red Absorption of Dyestuffs. A. Schiller.** *Zeits. f. Physik,* 105. 3–4. *pp.* 175–192, 1937.—Twenty organic dyestuffs in acetic acid solution are investigated in the photographic infra-red. Intensities are measured and the width of the bands are compared with the frequency corresponding to maximum absorption. W. R. A.

**2629. Infra-Red Absorption and Fluorescence Spectra of Rare-Earth Ions in Solids. H. Gobrecht.** *Ann. d. Physik,* 28. 8. *pp.* 673–700, *April,* 1937.—Absorption and fluorescence spectra of the rare-earth sulphates $R_2(SO_4)_3 \cdot 8H_2O$ are measured in the infra-red at −180° C. Absorption spectra of borax beads impregnated with rare earths are also recorded. The fluorescence spectra are regarded as transitions from an energy level to the whole ground term multiplet, in contradiction of the selection rules. Screening constants for four fluorescing elements are determined. Comparison with the Stark effect produced by the electric fields of the crystals permits the symmetry of the field to be determined. C. B. A.

**2630. Infra-Red Absorption Spectrum of the Deuterium Sulphides. A. H. Nielsen and H. H. Nielsen.** *J. Chem. Phys.* 5. *pp.* 277–283, *May,* 1937.—The spectra of HDS and $D_2S$ have been investigated under high dispersion using a grating spectrometer. An absorption band at $9 \cdot 0\mu$ in HDS has been identified as $\nu_2$ and has an average spacing of the rotation lines of about $6 \cdot 85$ cm$^{-1}$. In $D_2S$ bands were located at $3975\mu$, $5 \cdot 0\mu$ and $10 \cdot 7\mu$ which have line spacings of $4 \cdot 8$ cm$^{-1}$, $5 \cdot 0$ cm$^{-1}$, $5 \cdot 0$ cm$^{-1}$ and may be identified as $\nu_1 + \nu_2$, $\nu_3$ corresponding to a similar identification in $H_2S$. As in $H_2S$, $\nu_2$ appears to have a $Q$ branch while $\nu_3$ does not. If this is actually so, $\nu_2$ must arise from a vibration of the electric moment parallel with the axis of least moment of inertia and $\nu_3$ from a vibration along the middle axis. Since $\nu_2$ is a vibration parallel with the symmetry axis of the triangle then this axis must be identified with the axis of least moment of inertia. This argument supports the acute-angled model suggested by Sprague and Nielsen, and the evidence is interpreted to favour a vertex angle of 85° instead of the 110° angle of Bailey, Thompson and Hale. AUTHORS.

**2631. Infra-Red Absorption of Acetic Acid Solutions. W. Gordy.** *J. Chem. Phys.* 5. *pp.* 284–287, *May,* 1937.—The characteristic vibrational band associated with the C = O group of acetic acid has been studied as a function of concentration of acetic acid in benzene, in $CCl_4$, and in isopropyl ether. The effects of benzene and $CCl_4$ on the band were approximately the same. In both solvents the band became sharper, its intensity was increased, and its centre was shifted to the longer wave-lengths. For concentrations of acetic acid as low as 6 % the shift amounted to $0 \cdot 15\mu$. Although in isopropyl ether solution there was a measurable shift of the band to the longer wave-lengths, the shift was small compared to that observed for benzene and $CCl_4$ solutions. It is suggested that the changes in the C = O acetic acid band are likely due to variations in the polymerisation of the acetic acid as the concentrations is varied. However, the position of the band does not approach that for the vapour state in any of these solvents. Ethyl acetate was also studied in benzene and in isopropyl ether; no shifts could be detected in the C = O band. AUTHOR.

**2632. Absorption Spectra of Crotonaldehyde and Acrolein. F. E. Blacet, W. G. Young and J. G. Roof.** *Am. Chem. Soc., J.* 59. *pp.* 608–614, *April*, 1937.—A modified procedure for obtaining molecular extinction coefficients is described. Working with the vapour phase, the u.v. absorption spectra of crotonaldehyde and acrolein are determined quantitatively. Experiments designed to test for the presence of *cis*-crotonaldehyde in the commercial product gave results which indicate that this form of the aldehyde is not present. AUTHORS.

**2633. Absorption of Light by Imido-Porphyrins. A. Stern and Franziska Pruckner.** *Zeits. f. phys. Chem.* 178. *Abt. A.* 6. *pp.* 420–436, 1937.—It is found that the absorption of the 16-atom ring system of the porphyrins is markedly affected by the introduction of CN-groups. Regular changes are observed with increase in the number of CN-groups introduced, so that it becomes possible to deduce from observed absorption spectra the number of such groups in the molecule. The cause of the observed effects is discussed and the absorption of tetraimido-porphyrin is compared with that of phthalocyanin. The effects of substitution and change of solvent on the absorption of the imido-porphyrins are found to be similar to those for the porphyrins. L. A. W.

**2634. New Absorption Spectrum of $S_2$. H. Cordes.** *Zeits. f. Physik*, 105. 3–4. *pp.* 251–264, 1937.—A band system observed between 2488 and 3396 Å in the discharge in a S–$SO_2$ mixture, has been ascribed to $S_2$. The band heads have been arranged in series and transitions from the metastable $\sigma_g^2\pi_u^4\pi_g^2\ {}^1\Sigma_g^+$ state to excited ${}^3\Pi_u$ and ${}^1\Pi_u$ states established. The ${}^3\Pi_u$ level shows a disturbance in the higher oscillation terms and predissociation sets in at 36,080 $cm^{-1}$. The dissociation products are taken to be two S atoms in the ${}^3P$ and ${}^1S$ states. F. S.

**2635. Induced Predissociation of $Te_2$ Submitted to an Intense Magnetic Field. E. Olsson.** *Comptes Rendus*, 204. *pp.* 1182–1184, *April* 19, 1937.—The absorption of $Te_2$ vapour in a magnetic field of 45,000 gauss was observed with a dispersion of 20 Å/mm. Bands with $v' = 5$ to 15 increase in intensity and become diffuse, the effect being a maximum for $v' = 11$. The effect for those with $v' > 15$ is masked by the isotope effect. This agrees with Smoluchowski's work on the quenching of fluorescence in a magnetic field, but disagrees with the observations of Kandatjew and Lauris on induced predissociation in the presence of a foreign gas. H. G. C.

**2636. Absorption Spectrum of Potassium Cobaltous Thiocyanate. O. R. Howell and A. Jackson.** *Chem. Soc., J. pp.* 621–626, *April*, 1937.—The absorption spectra of a series of aqueous solutions containing a fixed amount of $CoCl_2$ with increasing concentrations of KCNS are recorded. Over a range of concentration of KCNS corresponding to a variation of the relative numbers of KCNS to water molecules from 1 to 4, the increase in intensity of the principal bands is linear. A mechanism is proposed for the chemical changes involved. C. B. A.

**2637. Analysis of Gadolinium Spectrum. G. Piccardi.** *Accad. Lincei, Atti*, 25. *pp.* 44–46, *Jan.* 3, 1937.—Researches on Gd are not conveniently conducted on the basis of absorption spectra as this absorption occurs chiefly in the ultra-violet and necessitates the use of photography and instruments mounted with such substances as quartz. The author has therefore applied his method of molecular spectra used previously for other rare earths to Gd. The oxide of Gd was used and a temperature employed which gave a maximum brightness and permitted the existence of the diatomic oxide GdO. Two new systems of bands have been discovered at λ 4615 and λ 4892 increasing rapidly in intensity on diminution of temperature, invisible in the spark, scarcely seen in the arc spectrum, but very brilliant in the flame with oxide. Observations can be made with a proportion of Gd of 1 : 1000. The minimum concentration observable in the author's solution was 0·1%, *i.e.*, about 0·05% of $Gd_2O_3$. J. J. S.

**2638. Analysis of Samarium Spectrum. G. Piccardi.** *Accad. Lincei, Atti*, 25. *pp.* 86–87, *Jan.* 17, 1937.—Although researches on Sm are most conveniently carried out by observations on the absorption spectrum of its solutions, like those in the case of the rare earths, yet the method of molecular spectra is useful as Sm is frequently found mixed with Gd in operations of fractional crystallisation. The spectrum of the oxide of Sm, probably emitted by the monoxide SmO, appears very complex. It is composed by very fine bands between λ 4300 and λ 6700, and chiefly distributed between λ 5800 and λ 6600 where the most intense are found. In the brightest part of all between λ 6350 and λ 6600 there occur four very brilliant bands of wave-lengths 6511, 6533, 6557, 6570, stated in order of decreasing intensity. With this disposition of the spectrum of SmO, it is able to coexist with that of GdO, and the most intense bands of GdO can be seen distinctly separated from those of SmO. With concentrations of 1% the flame is brilliantly coloured red and other groups of bands can also be distinguished. With a concentration of 10% the whole spectrum appears very brilliant. A photograph of the spectrum of SmO is given. J. J. S.

**2639. Term Schemes for Carbon Monoxide. Part I. Vibration Terms and Rotation Constants of the $a^1\,{}^3\Sigma^+$ States. R. Schmid and L. Gerö.** *Zeits. f. Physik*, 105. 1–2. *pp.* 36–44, 1937.—The molecular spectrum of CO is examined in the region 57,763 to 88,710 cm$^{-1}$. to include transitions involving the $a^1\,{}^3\Sigma^+$ states. The vibration bands tend to a convergence at 89,620 cm$^{-1}$. (11·06 V). Dissociation of CO from the $a^1\,{}^3\Sigma^+$ states give rise to C (${}^5S_u$) + O (${}^3P_g$) atom terms, and corresponds with the limit of the predissociation range in the $b\,{}^3\Sigma$ state. W. R. A.

**2640. Temperature of Freely Burning Carbon Arc Light from CN Bands. W. Lochte-Holtgreven and H. Maecker.** *Zeits. f. Physik*, 105. 1–2. *pp.* 1–15, 1937.—The spectrum of a freely burning C arc is photographed with high dispersion through an aperture bored in an electrode and the CN band 3883 Å is photometrically evaluated. Self reversal, overlapping of lines and inhomogeneity of the emitting gas column are taken into due consideration. From the photometric results the temperature on the axis of the normally burning arc is found to be 7600° K. A weakly overloaded arc has a corresponding temperature of 6700° K and a strongly overloaded one, the so-called hissing arc, has a temperature of 8700° K. J. E. K.

**2641. Birge-Sponer Method of Vibrational Extrapolation. R. K. Asundi and R. Samuel.** *Indian Acad. Sci., Proc.* 5*A*. *pp.* 235–243, *March*, 1937.—The correlation of molecular and atomic terms is of great importance for the determination of the electronic configuration of the diatomic molecule, and a knowledge of the excitation energy E of the dissociation products is essential. This latter is generally obtained by a linear extrapolation of the vibrational levels. Generally, however, the values so obtained are too high. It is now pointed out that it is not the actual values of D′ and D″ that are of importance, but their difference

$D' - D''$, and that in many cases the errors in $D'$ and $D''$ more or less cancel out. A number of illustrations are given. [See following Abstract.] A. H.

**2642. Structure of $N_2^+$ and Its Bearing on the Theory of Valency. R. K. Asundi and R. Samuel.** *Indian Acad. Sci., Proc.* 5*A*. *pp.* 244–248, *March*, 1937.—Discusses the relation between bond energies and electronic configurations in the case of $N_2^+$. The values of D employed are those obtained earlier [see preceding Abstract]. A. H.

**2643. Calculation of the Fundamental Modes of Vibration of $C_2H_4$, $C_2D_4$, and $C_2H_2D_2$. A. Verleysen and C. Manneback.** *Ann. Soc. Sci. de Bruxelles*, 57. *pp.* 31–38, *March* 16, 1937.—In continuation of previous work [see Abstract 705 (1937)] the fundamental modes of vibration of these substances in the plane of the molecule are calculated. Diagrams are given of the vibrations, which are related to the spectra. The relations between the spectra of $C_2X_4$ and those of the isomers of $C_2H_2D_2$ are investigated. The vibrations of the molecule can be considered composed of the internal vibrations of the radicals or the vibrations of the whole radicals, coupled or not by the elastic C–C bond. H. G. C.

**2644. Calculation of Vibration Frequencies of $N_2O_4$. J. Duchesne.** *Comptes Rendus*, 204. *pp.* 1112–1114, *April* 12, 1937.—The vibrational frequencies of $N_2O_4$ have been evaluated from the equations of Delfosse [see Abstract 3887 (1935)] and Manneback and Verleysen [see Abstract 705 (1937)], and the results compared with the experimental values of Sutherland [see Abstract 4104 (1933)]. W. R. A.

**2645. Level Scheme and Band Spectra of $N_2$ and $N_2^+$. A. van der Ziel.** *Physica*, 4. *pp.* 373–378, *May*, 1937. *In English.*—It is pointed out, that Savard's determination of the energy of dissociation of $N_2$ and $N_2^+$ is in error. The best values for the energy of dissociation of $N_2$ and $N_2^+$ are 7·35 V and 6·32 V respectively, whereas the best value for the ionisation potential of $N_2$ is 15·51 V, given by Hopfield and Mulliken. In spite of the work of Savard the position of the state $^2\Pi_u$ of $N_2^+$ in the level scheme is still uncertain. Indications are given that Kaplan's arrangements of the levels of some new u.v. bands in the level scheme of $N_2$ is incorrect. In the last paragraph attention is paid to the predissociation in the first positive group of $N_2$ which is caused by a $^3\Delta$ level. AUTHOR.

**2646. Vibration Spectra and Molecular Structure. Part II. Force Constants of C—C and C—O Bonds in Organic Molecules. L. G. Bonner.** *J. Chem. Phys.* 5. *pp.* 293–297, *May*, 1937.—Force constants are calculated from known vibration frequencies for several of the simpler organic molecules by an approximate method involving neglect of the interactions between motions of H atoms and other atoms. Frequency expressions are given for several special forms of the triatomic molecule, and the C—C and C—O force constants are calculated for ethane, propane, cyclopropane, ethylene oxide, ethyl alcohol, isobutane, dimethyl ether, and methyl alcohol. The values obtained are, in general, in the neighbourhood of 3·8 and 4·5 × $10^5$ dynes/cm., respectively. [For Part I see Abstract 707 (1937).] AUTHOR.

**2647. Double Minimum Problem Applied to the Ammonia Molecules. F. T. Wall and G. Glockler.** *J. Chem. Phys.* 5. *pp.* 314–315, *May*, 1937.—A simple quantum mechanical calculation has been made to obtain the doublet separations for the parallel type frequencies of the ammonias. The calculated values for the separations are: $NH_2D$ (21), $NHD_2$ (11) and $ND_3$ (5·8) cm$^{-1}$., which compare favourably with observed values: $NH_2D$ (20), $NHD_2$ (10) and $ND_3$ (3·4) cm$^1$. AUTHORS.

**2648. Long Range Interactions Between Dipole Molecules. H. Margenau and D. T. Warren.** *Phys. Rev.* 51. *pp.* 748–753, *May* 1, 1937.—The first-order van der Waals forces between symmetrical top molecules which carry a dipole along their figure axis are calculated. Their strength is compared with that of other interactions, and found to be greater than London's second-order effect for linear dipoles over the main part of the range of the latter. A simple preliminary theory of the effect of these forces on the width of spectral lines in bands of polyatomic molecules is given, and it is shown that they lead to results of the correct order of magnitude. AUTHOR.

**2649. Rotational Structure of $^4\Sigma \rightarrow {}^4\Pi$ Bands. A. Budó.** *Zeits. f. Physik*, 105. 1–2. *pp.* 73–80, 1937.—Formulæ are advanced for deriving the form of the rotational fine structure associated with the $^4\Sigma \rightarrow {}^4\Pi$ transitions of a diatomic molecule. These are discussed with particular reference to $O_2^+$ in which there are 48 possible modes of transition. W. R. A.

**2650. Correction of Continuous Spectra for the Finite Resolution of the Spectrometer. C. Eckart.** *Phys. Rev.* 51. *pp.* 735–738, *May* 1, 1937.—The relation between the theoretical intensity function of a continuous spectrum and the intensity measured with an ionisation chamber (or counter) and a spectrometer, is discussed. It is shown that while the problem of correcting the observed intensity for the finite resolution of the spectrometer does not always have a mathematically unique solution, the requirement that the theoretical intensity have a smooth graph is sufficient to make the solution practically unique. On this basis, an approximate solution of the problem is given, which involves the first and second differences of a set of equally spaced measurements. A second method of solution is discussed which involves the scansion of a template of the measured intensity wave-length curve by a photoelectric cell connected to a recording galvanometer. This method has practical disadvantages but illustrates several theorems derived analytically in the earlier part of the paper. AUTHOR.

**2651. Continuous Absorption Spectrum of Methyl Iodide. D. Porret and C. F. Goodeve.** *Faraday Soc., Trans.* 33. *pp.* 690–693, *May*, 1937.—Quantitative measurements of the absorption spectrum of $CH_3I$, made over a wide range of tube lengths, are described. The absorption spectrum is continuous and it is suggested that the molecule dissociates into a $CH_3$ radical and an I atom. The significance of a second absorption maximum in the spectrum is discussed. A. H.

**2652. New Fluorescence Bands in Cadmium Vapour. A. Kotecki.** *Acad. Polonaise Sci. et Lettres, Bull.* 10*A*. *pp.* 560–567, *Dec.*, 1936. *In German.*—Cd vapour at 550–900° C., irradiated with the light of a Mg spark, gives in the region 2800–3000 Å a number of fluorescence bands, 7 of which have already been observed [see Abstract 4966 (1934)]. In the region 2600–2800 Å the author has observed, superposed on a continuum, 17 new "fluctuation bands," whose wave-number separations decrease with wave-length. Since these bands disappear on filtering the exciting light through glass, they cannot be due to anti-Stokes fluorescence. Excitation with a $H_2$ continuum filtered through uviol glass gives results similar to those obtained with the spark. The wave-lengths of maximum intensity of the fluorescence bands coincide with those observed in absorption, and the amount of polarisation in the fluorescence is the same as that in the bands observed earlier. The results are interpreted by means of a proposed fluorescence mechanism analogous to that invoked to explain the previous observations. A. Hu.

**2653. Influence of Concentration on Photoluminescence of Trypaflavine Solutions. (Miss) A. Wrzesińska.** *Acad. Polonaise Sci. et Lettres, Bull.* 10*A*. *pp.* 568–574, *Dec.*, 1936. *In French.*—Certain discrepancies observed between the photoluminescence spectra of trypaflavine obtained from solutions in different substances are investigated. Freshly-prepared glycerin solutions gave results differing both from those of other observers and from previous results of the same observer. The discrepancies are traced to real differences in the spectral composition of the luminescence corresponding to differences of concentration in the solutions. Spectrophotometric curves are given for concentrations between $10^{-3}$ and $10^{-4}$ gm./cc., and for temperatures between 20 and –180° C., a distinction being made between bands due to fluorescence and to phosphorescence. A tentative explanation of the results attributes the bands to 2 kinds of molecule, one formed by polymerisation from the other. The effect of decreasing temperature in weakening instead of intensifying the band due to the polymer must be attributed to a secondary cause, such as oxidation of the dye in solution. A. Hu.

**2654. Resonance Excitation of the Fundamental Doublet of Cu in CuCl Vapour. J. Terrien.** *Comptes Rendus*, 204. *pp.* 679–682, *March* 1, 1937.—If strong light from an arc between Cu electrodes is passed through CuCl vapour the Cu doublet is observed in the fluorescence radiation emitted by the gas. A number of experiments lead to the conclusion that the mechanism of the excitation of this doublet consists in the photodissociation of a molecule, with a subsequent excitation of the liberated Cu atom by Cu radiation. R. P.

**2655. Change of Structure of Spectral Lines Due to Simultaneous Action of Homogeneous Electric and Magnetic Fields. W. Steubing.** *Preuss. Akad. Wiss. Berlin, Ber. Nos.* 30–31. *pp.* 427–435, 1936.—The component arrays of the terms of the first subsidiary series of ortho and parhelium undergo considerable changes in the simultaneous presence of electric and magnetic fields which depend more on the ratio than the absolute magnitude of the fields. Three phases occur in the splitting of the lines into components in the case of perpendicularly crossed fields; the first is when E/H (in volts per cm. divided by gauss) is less than 1/5 and the normal Zeeman effect is observed, the second phase is for $E/H > 1/5$ but $< 5/4$ when additive Zeeman and Stark effects occur, *i.e.* the known Stark components are appreciably magnetically split, the third phase is one of instability of Stark components the lines being broad and blurred. The ratios $E/H = 1/5$ and $5/4$ are "critical ratios" at which sharp arrays of components occur containing some lines which are observed neither in the Zeeman nor in the Stark effects. For fields crossed at 45° a "critical ratio" occurs when the ratio of electric field to the component of the magnetic field perpendicular to it is 5/4. The above critical ratios are for the first members of the series, for higher members the critical ratios are a few per cent lower. J. E. K.

**2656. Zeeman Effect of Doubly Ionised Cerium. T. L. de Bruin, J. N. Lier and H. J. van de Vliet.** *K. Akad. Amsterdam, Proc.* 40. 4. *pp.* 334–339, 1937.—Details are given of the Zeeman effect for Ce III.

The spectrograms were obtained in the third order of a 20 ft. grating, and fields of up to 38,500 gauss employed. Some 29 lines were examined. A. H.

**2657. Absorption Spectra and Zeeman Effect of Praseodymium Salts. A. Merz.** *Ann. d. Physik,* 28. 7. *pp.* 569–602, *April,* 1937.—The absorption spectra of $Pr^{+++}$ ions in several solid compounds, prepared from the pure nitrate, were examined at the temperature of liquid hydrogen and in a magnetic field. The number of lines observed depends upon the crystal symmetery while the kind and magnitude of their Zeeman effects is in qualitative agreement with the theory of Kramers and Bethe. The lines are arranged in groups according to a term-scheme on the $4f^2$ configuration. This agrees with results of Gobrecht in the infra-red. The molybdate was also obtained in the form of thin leaves ; the two crystal forms have different absorption spectra and Debye-Scherrer diagrams. The substitution of heavy water in $Pr_2(SO_4)_3 + 8H_2o$ made little change in the position of absorption lines. The intensity of absorption in the visible was measured for some of the compounds. F. S.

**2658. Influence of Temperature on the Combination Spectra of Liquid and Gaseous $CCl_4$. S. A. Ukholin.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 14. 5. *pp.* 271–272, 1937. *In French.*—$CCl_4$ enclosed in a thick wall quartz tube was heated between 50 and 250° C. as a liquid and up to 270° C. and 25 atmos. as a gas, and the diffusion spectrum given by 4358 Å measured. Many second and third order rays are observed. The frequencies of $D_1$ and $D_2$ enter into most of these as in the case of infra-red absorption. At 250° C. the second and third order rays are stronger in relation to the first order rays than at 20° C. The first order rays increase in width and intensity with increasing temperature. Stokes and anti-Stokes lines behave differently. H. G. C.

**2659. Raman Spectra of Simple Molecules. R. Ananthakrishnan.** *Indian Acad. Sci., Proc.* 5*A. pp.* 285–300, *March,* 1937.—The Raman spectra of dimethyl ether, phosgene, *n*-butane, ethylene diamine, ethylene glycol, ethylene dichloride, ethylene dibromide, acetylene tetrachloride, acetylene tetrabromide and hexachloroethane are studied afresh. The Raman frequencies of phosgene are classified with the aid of polarisation data. Polarisation measurements are also made in the case of *n*-butane, ethylene glycol, ethylene dichloride, ethylene dibromide, and acetylene tetrabromide. A brief discussion of the spectra of the ethane derivatives in relation to the problem of " free rotation " is added. AUTHOR.

**2660. Raman Spectra of Compounds with Four- and Six-Coordination. Werner's Complexes. J. P. Mathieu.** *Comptes Rendus,* 204. *pp.* 682–683, *March* 1, 1937.—The Raman spectra of a number of Pt and Rh compounds are described and discussed. R. P.

**2661. Raman Spectra of Deuterium Compounds of Type $CD_3{\cdot}CO{\cdot}X$. W. Engler.** *Zeits. f. phys. Chem.* 35. *Abt.B.* 6. *pp.* 433–441, 1937.—The preparations of trideuteracetyl chloride ($CD_3COCl$) and trideuteracetic acid ($CD_3CO_2H$) are discussed. Raman spectra of these compounds have been investigated as well as those of acetic deuteracid ($CH_3{\cdot}CO_2D$), trideuteracetic deuteracid ($CD_3{\cdot}CO_2D$) and hexadeuteracetone ($CD_3{\cdot}CO{\cdot}CD_3$). Comparison between the spectra of the deuterium compounds and those of the analogous protium (H) compounds is made. Three groups of lines are found for each series (*a*) six frequencies attributable to chain vibrations, (*b*) four frequencies arising from inner vibrations of the $CH_3$- or $CD_3$-groups, (*e*) three bending frequencies. [See also Abstract 3690 (1936).] W. R. A.

**2662. Raman Effect at Low Temperature in Phosphorus Trichloride, Cyclohexane and Chlorobenzene. S. C. Sirkar and J. Gupta.** *Indian Journ. Phys.* 11. *pp.* 55–64, *Feb.*, 1937.—The Raman spectra of solid $PCl_3$, cyclohexane and chlorobenzene are studied at the temperature of liquid $O_2$. No new lines are observed near the Rayleigh line in the case of the first two substances, but in the case of chlorobenzene, four new Raman lines having $\Delta\nu$ in $cm^{-1}$. respectively equal to 49, 67, 86 and 105 are observed at the low temperature. The significance of this face as well as the probable origin of these lines is discussed in detail. In the case of the $PCl_3$ molecule, all the lines due to the vibrations $\nu_1$, $\nu_2$, $\nu_3$ and $\nu_4$ are slightly shifted at the low temperature from their respective positions at the room-temperature, and $\nu_3$ gives a sharp line accompanied by two weak satellites at the low temperature. These facts are discussed from the theoretical point of view. In the case of cyclohexane, the line 1266 $cm^{-1}$. is split up into two equally intense components at the low temperature, showing the twofold degeneracy of the line and confirming the conclusions of Kohlrausch and Stockmair that the probable symmetry of the molecule is $S_{6v}$. AUTHORS.

***2663. Raman Effect Investigations by New Crystal Powder Method. H. Conrad-Billroth, K. W. F. Kohlrausch and A. W. Reitz.** *Zeits. f. Elektrochem.* 43. *pp.* 292–293, *May*, 1937.—The principle of a novel experimental method for the investigation of the Raman effect of powdered crystals is described. Primary irradiation is by homogeneous blue light Hg 4358, previously purified by passage through a double monochromator, and the specimen under investigation is mounted so as to take the place of the photographic plate of an auxiliary spectrograph. The slit of this instrument is common to it and the spectrograph with which the Raman effect is photographed. With this type of optical system light of any given wave-length can only reach the photographic plate from a definite region of the specimen, so that interposition of a suitable screen cuts out primary light and makes possible the observation of feeble Raman lines which would otherwise be masked by a continuous background. With an improvised apparatus useful spectrograms are obtained with exposures ranging from 2 to 10 hr., only about 1 cc. of powder being required. It is believed that this performance can be much improved.

L. A. W.

***2664. Interrupted Arc for Spectral Analyses. J. H. McMillen and G. H. Scott.** *Rev. Sci. Instruments*, 8. *pp.* 121–123, *April*, 1937.—Constructional details are given of a method for obtaining uniform consumption of a sample. The sample is placed upon a horizontal electrode which not only rotates on its own axis but also moves laterally into the discharge, at the same time the other electrode has a piston-like motion to give an interrupted arc. A. H.

***2665. Photometric Comparison of Absorption Lines. A. A. Frost, D. W. Mann and O. Oldenberg.** *J.O.S.A.* 27. *pp.* 147–149, *April*, 1937.—Constructional details are given of an instrument suitable for picking out absorption lines of equal intensity. The instrument is being employed for the investigation of the intensities of absorption lines belonging to molecular bands for the purpose of quantitative chemical analysis. A. H.

***2666. Detection of Structure of Absorption Spectra. E. R. Holiday.** *Journ. Sci. Instruments,* 14. *pp.* 166–172, *May,* 1937.—A photographic plate is moved by means of a cam past the spectral image of the slit of a spectograph at a logarithmically increasing rate. The plate obtained is suited to the detection of detailed structure of absorption spectra and, by use of a reference spectrum, to the quantitative estimation of absorption. AUTHOR.

***2667. Logarithmic Sector Method of Spectrum Analysis. H. A. Wilhelm.** *Indust. and Engin. Chem.* (*Analytical Edition*), 9. *pp.* 170–172, *April* 15, 1937.—A new eyepiece for making readings on sector lines has internal comparison densities and an internal scale. Results obtained with it on logarithmic sector lines give a mean error per individual reading of ± 0·060 mm., which is one-third the error that has been reported for readings made with the ordinary measuring eyepiece. A high degree of accuracy is attainable in the determination of relative intensities of spectrum lines by means of the logarithmic sector and the new eyepiece. The result is an increase in the accuracy of this system of quantitative analysis. AUTHOR.

*** 2668. Quantitative Spectrum Analysis of Solutions of Metals. P. Jolibois and R. Bossuet.** *Comptes Rendus,* 204. *pp.* 1189–1190, *April* 19, 1937.—An apparatus is described whereby a spark of constant length at constant pressure and current can be maintained between a Pt anode and an electrolyte. The electrolyte may be changed without moving the apparatus. It is suitable for the spectrum analysis of metallic solutions and 0·32 mg. of Mn in 20 cc. of liquid can be measured. H. G. C.

**2669. Spectrum Analysis of Al-Mg Alloys. W. Seith and A. Beerwald.** *Zeits. f. Elektrochem.* 43. *pp.* 342–350, *May,* 1937.—The method of homologous pairs is not applicable. $\alpha$ and $\delta$ phases can be analysed quantitatively, provided the alloys are previously homogenised by quenching. For $\beta$ and $\gamma$, the u.v. spectrum is compared with a series of spectra of known alloys. If the photographic plate has straight-line characteristics, the differences in blackening for known Al and Mg lines give straight-line plots against log (concentration). Absolute blackening need not be determined if physical and photographic conditions are kept constant. Some sparking difficulties may arise when the test alloys have been kept in storage. D. R. H.

*See also* Abstracts 2290, 2400, 2416, 2425, 2426, 2476, 2499, 2587, 2698, 2716, 2781, 2825.

## VISION.

**2670. Non-Homogeneous Sensations : New Theory of Sensation Discrimination. W. D. Wright.** *Brit. J. Psych.* (*Gen. Sect.*) 27. 4. *pp.* 394–398, 1937.—It is suggested that the reason why we cannot see a difference of brightness between two uniformly illuminated areas if their illuminations differ by less than a certain finite amount is that each area comprises a large number of elements of slightly different apparent brightnesses. An experiment is described in which such differences in brightness were accentuated by making the stimulus non-uniform. The smallest perceptible difference of brightness was found to be increased. This is regarded as evidence favouring the view suggested. W. S. S.

**2671. Variation of Sensory Thresholds with the Rate of Application of the Stimulus. G. C. Drew.** *Brit. J. Psych.* (*Gen. Sect.*) 27. 3. *pp.* 297–302, 1937.—The subject viewed a 5° white field whose brightness was increased by a given amount uniformly in a time varying from 0·01 to 5·0 sec. The smallest increase of brightness which could be detected was determined for the various times of application. For times less than 0·1 sec. the threshold increase was nearly constant but thereafter it increased with application time from about 13% of the initial field brightness to about 45%. The explanation of the results in terms of sensory adaptation is discussed. W. S. S.

**2672. Electrical Responses of Dark-Adapted Frogs' Eyes to Monochromatic Stimuli. R. Granit and A. Munsterhjelm.** *J. Physiol.* 88. *pp.* 436–458, *Jan.* 1937.—The *b*-wave of the electroretinogram of dark-adapted frogs' eyes is recorded with a string galvanometer and a directly coupled amplifier. Monochromatic stimuli 0·010 μ apart have been used. The b-wave is shown to be multiple and consists of several components of different latent period, size, and rate of rise and decay. The height of the *b*-wave has been plotted against wave-length and at high intensities, curves with broad maxima are found and the *b*-waves show specific differences with respect to wave-length. At low intensities either broad or narrow curves are found, symmetrical about a maximum of about 0·507 μ, and the *b*-waves show no specific difference with respect to wave-length. The results are compared with the absorption spectrum for visual purple and various sources of error tending to invalidate such comparisons are discussed. W. D. W.

**2673. Electrical Responses of Light-Adapted Frogs' Eyes to Monochromatic Stimuli. R. Granit and C. M. Wrede.** *J. Physiol.* 89. *pp.* 239–256, *April,* 1937.—The electroretinograms of light-adapted frogs' eyes are recorded. Curves showing the size of the *b*-wave, its rate of rise and the size of the off effect as a function of wave-length are given, special precautions having been taken to avoid dark adaptation. The initial phases of the electroretinogram show a specific effect of wave-length only after dark adaptation. The isolated cone response does not show a specific effect. Excessive light adaptation depresses red less than green. The results show that there must be at least three substances, retinal elements and types of fibres in the eye: (i) rods containing visual purple, (ii) rods (or cones) containing a substance absorbing light in the blue and violet, (iii) cones. The results also suggest that there are at least two types of cone overlapping with respect to distribution of sensitivity to spectral light. W. D. W.

**2674. Constancy of the Blue Arc Phenomena. S. M. Newhall.** *J.O.S.A.* 27. *pp.* 165–176, *April,* 1937.—The author made a quantitative study of the brightness and colour of the blue arcs which in certain circumstances are seen to run from a light source viewed parafoveally to the projected position of the blind spot. The subject fixated a 2° comparison field provided by a trichromatic colorimeter and adjusted the mixture in this field by successive trials until it matched in colour and brightness the blue arcs produced by a 6° × 1/2° stimulus formed about 2° on the nasal side of the fixation direction. The stimulus was exposed for 0·5 sec. the arcs appearing and disappearing with the stimulus. It was found that the colour of the arcs varies only slightly with the colour of the stimulus. The arcs were only obtained with stimuli which were neither too feeble nor too intense but within these limits their brilliance showed comparatively small variations for a 100 to 1 change in stimulus intensity. The typical arcs had the following specification: dominant hue, 566c mμ;

saturation, 75%; brightness, 0·75 foveal photons. Pre-exposure of the retina to light strengthened the arcs while prolonged exposure to darkness weakened them. The arcs never persisted for more than 0·9 sec. however long the stimulus was exposed. On the theory of the mechanism of production of the arcs the results favour (*a*) electricity as the principal immediate stimulus (*b*) both achromatic and violet elements as the receptors of that stimulation. W. S. S.

*See also* Abstracts 2477, 2478.

## X-RAYS.

***2675. X-Ray Tube with Rotating Anti-Kathode. Fournier, Gondet and Mathieu.** *J. de Physique et le Radium*, 8. *pp.* 160–164, *April*, 1937.—The necessity which is frequently met, of cutting down the exposure times in the making of X-ray diffraction photographs, has led the authors to develop an X-ray tube embodying a large water-cooled anti-kathode which can be rotated. The rotation is obtained through a ground conical joint which is kept well greased. The construction of the tube is fully detailed. Speeds of rotation up to 3 or 4 r.p.s. are obtainable. Experiments with the tube are described and very satisfactory results are indicated. Current densities up to 600 *m*A for short periods are realisable. The results are in agreement with those of other workers using X-ray tubes with rotating anti-kathodes. G. O. B.

***2676. Tube for Production of Monochromatic and Fluorescent X-Rays. W. C. Pierce, C. M. Olson and D. P. MacMillan.** *Rev. Sci. Instruments*, 8. *pp.* 145–147, *May*, 1937.—An X-ray tube which may be used for the production of monochromatic rays of high intensity is described. The monochromatic beam is obtained by reflection from a crystal mounted within the tube. By a slight modification the tube may also be used for production of fluorescent X-rays from samples mounted close to the focal spot within the tube. AUTHORS.

**2677. Excitation of Characteristic X-Rays by Protons. M. S. Livingston, F. Genevese and E. J. Konopinski.** *Phys. Rev.* 51. *pp.* 835–839, *May* 15, 1937.—A qualitative study of the X-rays produced by protons of 1·76 eMV energy shows that these rays are the characteristic K and L radiations from the targets used. The variation of intensity with proton energy and with atomic number is found to be in agreement with that expected theoretically. AUTHORS.

**2678. Ionisation of Air by Electrified Dielectrics. F. Perrier.** *Comptes Rendus*, 204. *pp.* 1174–1175, *April* 19, 1937.—Experiments are described showing that the discharge of an electrified dielectric is accompanied by ionisation of the air; thus favouring Reboul's explanation of the inversion of current produced when a dielectric is discharged in an ionisation chamber, rather than that of Eichenberger [see Abstract 4443 (1936)]. C. A. S.

**2679. Scattering of X-Rays at Very Small Angles. H. H. Penley and J. A. Gray.** *Canad. J. of Research*, 15. *Sect. A. pp.* 45–47, *March*, 1937.—The scattering of X-rays at small angles (minutes of arc) in commercial samples of charcoal and powdered graphite and in anthracene precipitate is investigated. In addition, the effect of pressure on the scattering in Shawinigan charcoal was determined. An absorption method, which is described, is used and the results are shown graphically in the accompanying figure. AUTHORS.

**2680. X-Ray Investigation of Free Electrons in Metals. P. Debye.** *Phys. Zeits.* 38. *pp.* 161–165, *March* 15, 1937.—The number of free electrons in a metal ought to bear a relationship to the scattering power of the metallic atoms for X-rays, since each atom may be supposed to have lost one or more electrons. The magnitude of this effect, however, for coherent scattering is extremely small at practicable angles of measurement, but it is suggested that measurement of the incoherent scattering would afford evidence concerning the number of free electrons. Theoretical calculations are given. [See following Abstract.] J. T.

**2681. Scattering of X-Rays by Free Electrons in Be. W. Scharwächter.** *Phys. Zeits.* 38. *pp.* 165–176, *March* 15, 1937.—The possibility of the determination of the number of free electrons in a metal by measurement of the incoherent scattering of X-rays [see preceding Abstract] is tested in the case of Be. Monochromatic $Cu_{K\alpha}$-, $Mo_{K\alpha}$- and $W_{L\beta}$- rays are obtained by reflection from calcite and rock-salt. The scattered rays are measured photographically, a vacuum camera being used. Theoretical intensity curves are calculated for the case in which the two conductivity electrons in Be are bound and for that in which they are free, and these are compared with the experimental curve. Agreement is found between the latter curve and the free-electron curve. J. T.

**2682. Auger Effect in Germanium. M. Ference, Jr.** *Phys. Rev.* 51. *pp.* 720–725, *May* 1, 1937.—Auger electrons ejected from the L and M levels of Ge are studied by means of a magnetic spectrograph in which the ordinary photographic plate is replaced by a small Geiger-Müller electron counter. The maximum energy of the Auger electrons arising from the $K{-}L^2$ transition is found to be 8590 ± 15 V. The kinetic energies of ejected Auger electrons are computed from theoretical considerations and shown to agree well with those observed. An attempt is made to separate the band of electrons from the L shell into three groups and compare their intensities with theory, but is not entirely reliable because of too low resolving power of the spectrograph. A reliable estimate of the relative probability of transitions $K \rightarrow L^2$ and $K \rightarrow LM$ is made and found to be 100 : 31, which is to be compared with 100 : 58 calculated from the theory. AUTHOR.

**2683. Simultaneous Reflection of X-Rays by Two Planes in a Crystal. J. Weigle and H. Mühsam.** *Helv. Phys. Acta,* 10. 2. *pp.* 139–156, 1937. *In French.*—On X-ray spectrograms white lines which have the appearance of absorption lines are often observed on the continuous background. They are independent of the antikathode and vary only with the crystal employed for the diffraction of the X-rays. They are due to the fact that, for the wave-length considered, two crystal planes can at the same time, reflect the X-rays; part of the energy which was reflected in the considered direction, is now propagated in a different direction. The theory of these white lines is given for a mica crystal and the calculations are verified experimentally. The white lines being characteristic of the crystal should serve to determine the structure constants of a crystal with precision. In the second part of the paper the Laue-Ewald theory is applied, in a simple case, to the formation of these lines. C. J. B. C.

**2684. Intensities of X-Ray Reflections from Single Crystals of Sodium Between 120 and 370° K. R. H. V. M. Dawton.** *Phys. Soc., Proc.* 49. *pp.* 294–305; *Disc.*, 305–306, *May* 1, 1937.—Single crystals of sodium are examined by X-rays in a temperature range of 120–370° K. Strong hysteresis in the reflecting-power is observed, but this vanishes when the crystals are chilled with liquid air. The normal temperature effect is measured with the chilled crystals and the characteristic temperature is calculated from the Debye-Waller formula. AUTHOR.

**2685. Spectrographic Study of the Conduction Electrons of Magnesium and Silicon. J. Farineau.** *Comptes Rendus*, 204. *pp.* 1108–1110, *April* 12, 1937.—The K and L spectra of Mg and the K spectrum of Si are studied with a vacuum spectrograph employing either a quartz or curved mica crystal, or for the L spectrum a concave grating. The long wave-length edge of the Mg $K\beta_2$ line is situated at 9·496 Å, and had a width of 7·5 ± 0·5 eV. The L line has its long wave-length edge at 251 Å and has a width corresponding to 8·5 ± 1·5 eV. Assuming the two M electrons of Mg to be free it is calculated that they should occupy an energy band of 7·3 eV. in good agreement with the experimental value. The $K\beta_2$ line of Si has a width of 18 ± 1.5 eV, the intensity maximum being 4 eV from the long wave-length edge. On the hypothesis of 4 free electrons the width is found to be 13·5 eV, and the intensity should fall sharply to zero at the long wave-length edge. It is concluded that the outer electrons of Mg are free, but that those of Si are not, which is in accordance with its low conductivity. C. J. B. C.

***2686. X-Ray Emission Spectra of Sulphides and Sulphates. J. Valasek.** *Phys. Rev.* 51. *pp.* 832–834, *May* 15, 1937.—A target for exciting X-ray emission spectra of chemical compounds is described. The wave-lengths of the Kβ lines of alkaline earth sulphates and of some semiconducting sulphides are given. Using these results and the wave-lengths of the K absorption edges, the energy gap between the occupied and unoccupied zones in these crystals is obtained. The results for the sulphates are compared with the results previously obtained for the corresponding sulphides. In order to account for the changes in emission wave-lengths from compound to compound, a non-uniform displacement of energy levels is needed in addition to the Madelung energy. A recent article by Slater and Shockley suggests one way in which this may be accomplished [see Abstract 5159 (1936)]. AUTHOR.

**2687. Structure of X-Ray K-Absorption Limits of Bromine, Iodine, and Their Compounds. B. Cioffari.** *Phys. Rev.* 51. *pp.* 630–637, *April* 15, 1937.—The double crystal spectrometer has been used to investigate the structure, width, and relative positions of the K-absorption limits of $Br_2$ in the vapour, liquid, and solid states; of $I_2$ in the vapour and solid states; and of some compounds of these elements. Curves of these absorption limits are presented. Tables are given of the widths of these limits, of the relative displacements of the limits in compounds, and of the positions of secondary structure. The absorption limit of $Br_2$ vapour possesses a pronounced structure near the short wave-length side. This structure does not appear in the absorption limit of either the liquid or solid, or of any of the compounds investigated, except IBr vapour. The absorption limit of solid iodine shows a faint structure near the short wave-length side. A similar structure is found in the absorption limit of the vapour, but no shift is detected. The iodine K-absorption limits of the compounds investigated show no measurable shifts. AUTHOR.

**2688. Striations in Laue-Diffraction Spots. L. Chrobak and J. Chojnacki.** *Acad. Polonaise Sci. et Lettres, Bull.* 1–2A. *pp.* 86–92, *Jan.–Feb.*, 1937. *In German.*—An explanation is given of the presence of striations in spots on Laue X-ray photographs. It is shown that they depend on the divergence of the primary beam, the position of the diffracting crystal with respect to the film and to the presence of characteristic wavelengths in the " white " radiation when an antikathode such as W is used in the X-ray tube. J. I.

**2689. Change of Brightness along Kossel Lines. M. v. Laue.** *Ann. d. Physik*, 28. 6. *pp.* 528–532, *March*, 1937.—The author's original theory of the Kossel effect is corrected and modified in order to explain the change from light to dark observed by Borrmann and Voges to take place along the Kossel lines in certain cases [see Abstracts 1259 and 1260 (1937)]. J. T.

**2690. X-Ray Diffraction in Liquids. B. S. Dželepow.** *Phys. Zeits. d. Sowjetunion*, 11. 2. *pp.* 157–167, 1937. *In German*.—A method is described for investigating the diffraction of X-rays in liquids. The results obtained for benzene, methyl and ethyl alcohols, and polymerised styrene are described. C. B. A.

**2691. Dynamic Theory of X-Ray Interference. F. Galperin.** *Phys. Zeits. d. Sowjetunion*, 11. 2. *pp.* 182–193, 1937. *In German*.—It is pointed out that Laue's theory of X-ray interference in crystals, which gives a zero value for the work done by the electromagnetic field in an arbitrary element of the lattice space during a vibration, is not in agreement with quantum mechanics. C. B. A.

***2692. Method of Obtaining Intense Diffraction Diagrams of Crystalline Powders with Monochromatic Radiation. A. Guinier.** *Comptes Rendus*, 204. *pp.* 1115–1116, *April* 12, 1937.—A focussing arrangement, employing X-rays rendered monochromatic by a curved crystal, is described. It is possible to obtain strong photographs with short exposure times. Using a tube with a Cu anti-kathode, running at 32 kV and 30 mA, a good diagram of a Ni foil was obtained in 2 min. The dispersion corresponds to that of a Debye camera of 96 mm. radius. The whole apparatus could be enclosed in an evacuated chamber. It is specially suitable for studying lines of feeble intensity. C. J. B. C.

**2693. Azimuthal Intensity Distribution of X-Rays. K. Böhm.** *Phys. Zeits.* 38. *pp.* 334–335, *May* 1, 1937.—Investigations of the angular distribution of X-rays have frequently been complicated by scattering within the antikathode itself. To overcome this the author here uses very thin foils of Mg evaporated on to very thin films of celluloid. The investigations are carried out by the photographic method at a constant potential of 31 kV, using foils of 0·15μ and 0·45μ thickness. The angular range was 20° to 150°. All the results show a maximum at about 55°. The influence of diffusion within the foil is indicated by the greater width of the curves for the thicker foils when the results are plotted on a polar diagram. From the curves it is obvious that the intensity falls to zero at 0° and at 180°. G. O. B.

***2694. X-Ray Vacuum Spectrograph. C. M. Olson and W. C. Pierce.** *Rev. Sci. Instruments*, 8. *pp.* 147–150, *May*, 1937.—The essential details of a small, readily constructed, vacuum spectrograph are described. Unique features of the instrument are in the method for rocking the crystal and in the use of a mercury seal instead of a taper joint for crystal mounting. The instrument may be used with or without evacuation. AUTHORS.

*See also* Abstracts 2311, 2332, 2440, 2546, 2700, 2701, 2702, 2832.

# HEAT.

## CALORIMETRY.

**2695. Specific Heat of Copper. S. M. Dockerty.** *Canad. J. of Research*, 15. *Sect. A. pp.* 59–66, *April*, 1937.—An all-metal adiabatic vacuum calorimeter was used to determine the specific heat of copper over small temperature intervals from 30° to 200° K. The accuracy is considered to be within 0·05 % for the greater part of the range. A curve is given showing the variation with temperature of the characteristic temperature, $\theta$, for copper. AUTHOR.

**2696. Specific Heat of Anhydrous $MnCl_2$. O. Trapeznikowa and G. Miljutin.** *Phys. Zeits. d. Sowjetunion*, 11. 1. *pp.* 55–59, 1937. *In German.*—Measurements of $C_p$ were made over a temperature range from 13° to 130° K, but no anomaly suggestive of a Curie point was found in this region. L. G. C.

**2697. Electronic Specific Heat of Small Metal Particles at Low Temperatures. H. Fröhlich.** *Physica*, 4. *pp.* 406–412, *May*, 1937. *In German.*—If the size of the particle is so small that the distance between the quantum states of the electrons in it is comparable to $kT$, the specific heat is different from that of the bulk metal and depends on temperature in a complicated way. The problem is solved for the special case of particles of cubic shape, in which there is a special degeneracy. R. P.

***2698. Calorimeter for Measurements upon Liquids of High Vapour Pressure. K. L. Wolf and H. Frahm.** *Zeits. f. phys. Chem.* 178. *Abt.A.* 6. *pp.* 411–419, 1937.—A detailed description is given of a metal block calorimeter which operates under water. The apparatus is suitable for the determination of heats of dilution and reaction, specific heats, etc., of liquids with high vapour pressures, and can be used at temperatures between 20° and 50° C. The maximum error is estimated to be 0·3 %. L. A. W.

*See also* Abstracts 2707, 2708, 2720.

## CONDUCTION.

*See* Abstract 2866.

## DILATATION.

**2699. Thermal Expansion of Binary Systems in the Molten State. A. A. Leontjewa.** *Acta Physicochimica*, 6. 2. *pp.* 229–238, 1937. *In German.*—The experimental study of the construction of the isothermals of the specific volume and of the isothermal of deviation from additivity enables the process of melting to be investigated together with the molecular changes taking place. The addition of a glass-building substance (borax boranhydride) to a melt of the kations Na and K causes a compression of the volume and the formation of dipolar complexes frequently with dipolar bonds internally. The degree of association of the molecules of the melt and the possibility of formation of complexes depends only slightly on the temperature. They are chiefly determined by the weight ratio of the components of the mixture. E. H. D.

**2700. X-Ray Investigation of Pure Iron-Nickel Alloys. Part III. Thermal Expansion of Alloys Rich in Iron. E. A. Owen and E. L. Yates.** *Phys. Soc., Proc.* 49. *pp.* 307–314, *May* 1, 1937.—This part of the paper deals with the measurement of the parameters of pure Fe and Fe-Ni alloys in the $\alpha$ phase at different temperatures ranging from room-temperature to 600° C. From these measurements the coefficients of thermal expansion of the alloys were determined. The thermal expansion of Fe, 99·97 % pure, was obtained at temperatures between 0 and 500° C. The lattice parameter of Fe of this purity at 15° C. was found to be $2\cdot8605_0$ Å and the coefficient of thermal expansion at this temperature to be $10\cdot7 \times 10^{-6}$ per ° C. At all temperatures the addition of Ni to Fe at first lowered and afterwards increased the value of the thermal coefficient. [For Part II see Abstract 1723 (1937).] AUTHORS.

**2701. X-Ray Investigation of Pure Iron-Nickel Alloys. Part IV. Variation of Lattice Parameter with Composition. E. A. Owen, E. L. Yates and A. H. Sully.** *Phys. Soc., Proc.* 49. *pp.* 315–322, *May* 1, 1937.—In this part of the paper the variations of lattice parameter with the composition of the alloys is considered. 20 alloys in the $\gamma$ phase ranging in composition from 23 to 97 atomic % of Ni, and 4 alloys in the $\alpha$ phase ranging in composition from 3 to 16 atomic % of Ni were studied at different temperatures. At room-temperature, when Fe is added to Ni the Ni lattice expands almost linearly with the atomic composition until the lattice parameter reaches a maximum value of 3·5895 Å for an alloy the composition of which is 39 atomic % of Ni. On further addition of Fe the lattice contracts. The variation of the parameter of the $\gamma$ alloys with composition was examined at temperatures ranging up to 600° C. From the values of the lattice parameters the densities of pure Fe-Ni alloys over the whole range of composition from pure Fe to pure Ni were calculated. [See preceding Abstract.] AUTHORS.

**2702. X-Ray Investigation of Pure Iron-Nickel Alloys. Part V. Variation of Thermal Expansion with Composition. E. A. Owen, E. L. Yates and A. H. Sully.** *Phys. Soc., Proc.* 49. *pp.* 323–325, *May* 1, 1937.—The variation of the thermal coefficient of expansion with composition of the $\gamma$ alloys, as deduced from measurements of crystal parameters, agrees in the main with that found by Guillaume and by Chevenard, who made measurements on rods of the materials. Certain divergences, which may be due to differences in the purities of the alloys employed in the different investigations, have been observed. [See preceding Abstract.] AUTHORS.

## MELTING AND BOILING POINTS.

**2703. Freezing-Points of Alloys, and Valency Effects in Silver Alloys. W. Hume-Rothery and P. W. Reynolds.** *Roy. Soc., Proc.* 160*A*. *pp.* 282–303, *May* 18, 1937.—A method is described for the accurate determination of the freezing-points of alloys by means of cooling curves in which the temperatures are measured by a thermocouple. The possible sources of error are examined in detail, and by carrying out all determinations under identical experimental conditions, temperature measurements have been made which are consistent to a degree of accuracy varying from ± 0·1 to ± 0·3° C. Methods for determining the exact composition of the melt at the instant of freezing are investigated. The effect of supercooling is studied, and a method is developed to allow for errors caused by volatilisation of one constituent. The methods developed are used to investigate the liquidus curves of Ag-rich, Ag-Cd, Ag-In, Ag-Sn, and Ag-Sb alloys. If the freezing-points of the different alloys are plotted against the equivalent compositions (*i.e.*, the atomic percentage of solute multiplied by its valency), the points for the Ag-Sn and Ag-Sb alloys lie on a single curve in the range 960·5–880° C. The points for the Ag-Cd and Ag-In alloys in the range 960·5–920° C. lie on a single curve to a very high degree of accuracy, and in the range 920–880° C. they differ by not more than 1·1° C., the difference being in the direction to be expected from the experimental errors. The equivalent composition liquidus curve for the Ag-Sb and Ag-Sn alloys is, however, definitely higher than that for the Ag-In and Ag-Cd alloys, the maximum difference in the range considered being about 3° C. The initial depressions of the freezing-point of Ag produced by 1 atomic % of the above solutes are, therefore, not proportional to the factors 2 : 3 : 4 : 5, but to factors of the form $2a : 3a : 4b : 5b$, where $b$ is slightly less than $a$, although the whole numbers involved appear exact. AUTHORS.

**2704. Ebullioscopic Constants. C. S. Hoyt and C. K. Fink.** *J. Phys. Chem.* 41. *pp.* 453–457, *March*, 1937.—A recalculation of the values of the ebullioscopic constants by the equation of Rosanoff and Dunphy has been made for 18 common solvents. These agree closely with those calculated from the usual thermodynamic equation, provided the gas constant is corrected by the Berthelot equation. Experimental values check the theoretical when superheating is eliminated. Where any appreciable difference occurs between the two values, that calculated by the equation of Rosanoff and Dunphy is to be preferred. AUTHORS.

**2705. Process of Melting. M. Volmer and O. Schmidt.** *Zeits. f. phys. Chem.* 35. *Abt.B.* 6. *pp.* 467–480, 1937.—The process of the melting of crystals is considered from a general point of view, and papers on the subject are discussed. Experiments were carried out on Ga containing small amounts of Zn, Cu, Pb, Fe, Ni as impurities, and the procedure is described. It is suggested that in the melting of crystals the melting starts locally where there is a small amount of impurity, and there is not a general breaking down. This suggestion is discussed briefly from a theoretical and practical standpoint. E. H. D.

***2706. Di-n-Heptyl Phthalate as a Melting-Point Bath Liquid. P. P. T. Sah and Cheng-Heng Kao.** *Chinese Chem. Soc., J.* 5. *pp.* 86–88, *March*, 1937. *In English.*—For melting point baths at temperatures of 200–300° C. the bath liquid usually consists of concentrated $H_2SO_4$ or a vegetable oil. These have disadvantages in the form of the evolution of obnoxious or poisonous fumes, change of colour, etc. The method of preparing di-n-heptyl phthalate is given and its advantages as a bath liquid are (*a*) a faint fragrant odour, (*b*) below 300° C. there is practically no evolution of any vapour or disagreeable odour, (*c*) decomposition takes place at 320° C. but the vapours are far less disagreeable than with some other liquids, (*d*) the ester is a colourless liquid which turns slightly yellow on heating at high temperatures, and this can be removed by vacuum distillation. The decomposition point can be raised by adding 20% of beeswax. Di-n-butyl and di-iso-amyl phthalate are also satisfactory. E. H. D.

*See also* Abstracts 2330, 2369, 2699, 2860.

## TEMPERATURE, MEASUREMENT OF.

**2707. Influence of Dipole-Dipole Coupling on the Specific Heat and Susceptibility of a Paramagnetic Salt. J. H. van Vleck.** *J. Chem. Phys.* 5. *pp.* 320–337, *May*, 1937.—In view of the importance of the mutual magnetic potential energy of atomic magnetic dipoles, not to be confused with exchange interaction, in determining the temperature scale in the new very low region obtained by magnetic cooling, the partition function, and hence the entropy, specific heat, and susceptibility are calculated for a paramagnetic solid inclusive of dipole and simultaneously also feeble exchange coupling. The computation is made for atoms otherwise free, and also when subjected in addition to a crystalline Stark field. The method of partition functions contrasts with the usual, essentially static Lorentz method of representing dipole-dipole coupling by a local field, a procedure which is shown to be only a first approximation. Two types of extrapolation, based on a second approximation, are obtained, corresponding respectively to assuming a Gaussian distribution of energies for states with the same crystalline spin, and, more satisfactorily, to the use of the local field proposed by Onsager. [See following Abstract.]

N. M. B.

**2708. Magnetic Cooling Experiments. M. H. Hebb and E. M. Purcell.** *J. Chem. Phys.* 5. *pp.* 338–350, *May*, 1937.—Available experimental results on the magnetic cooling method are investigated in the light of (1) the electric crystalline fields acting on the magnetic ions of the paramagnetic salts used, and (2) the magnetic dipole-dipole coupling between these ions. These two factors produce anomalous specific heats and departures of the magnetic susceptibility from Curie's law below 1° abs. The deductions of van Vleck [see preceding Abstract] on specific heat and susceptibility are compared with experimental results for several salts. Fairly good agreement is obtained, although there is some uncertainty as to the effect of (2) on the susceptibility and hence on the relation between the empirical and Kelvin temperature scales. N. M. B.

*See also* Abstract 2640.

## THERMOCHEMISTRY.

**2709. Spontaneous Ignition under Pressure of the Simpler Aliphatic Hydrocarbons, Alcohols, and Aldehydes. G. P. Kane, E. A. C. Chamberlain and D. T. A. Townend.** *Chem. Soc., J. pp.* 436–443, *March*, 1937.—A brief account is given of previous investigations upon the influence of pressure on the spontaneous ignition of paraffin hydrocarbon–air media, indicating the relationship between ease of ignition in a low-temperature system at *ca.* 300–350° and the knocking propensities of the fuels concerned as observed in engine practice. In recent discussion of the chemical processes occurring in the low-temperature system and giving rise to knock, it has been assumed that aliphatic alcohols are less reactive than their parent hydrocarbons. It is now shown that, in the ethane series, ease of ignition is in the order aldehyde > alcohol > paraffin; in the propane series the same order is found, but the time-lags for the alcohol are greater than for the paraffin. With paraffins containing five or more carbon atoms, the order (from both the authors' experiments and others) is paraffin > alcohol. AUTHORS.

**2710. Influence of Pressure on Spontaneous Ignition of Simpler Olefines. G. P. Kane and D. T. A. Townend.** *Roy. Soc., Proc.* 160*A*. *pp.* 174–187, *May* 18, 1937.—Previous investigations into the influence of pressure on the spontaneous ignition of the paraffin hydrocarbons have been extended to the simpler olefines; ethylene, propylene, 1-butylene and 1-amylene. The ignition-point curves for members with more than three C atoms are not unlike those of corresponding paraffins, for a sharp fall was again observed over narrow critical pressure ranges to a lower temperature system, where cool flames are normally observed; and with a 2% amylene-air mixture two pressure minima in the lower system were located as with the higher paraffins. The main difference between the two series lies in the longer pre-flame time lags observed with the olefine-air media and in the weak luminosity and feeble pressure pulses associated with the cool flames to which they give rise. Further experiments are described in which small amounts of $NO_2$ and di-ethyl ether were employed as promoters. AUTHORS.

*See also* Abstracts 2698, 2757.

## THERMODYNAMICS.

**2711. Derivation of Second Law of Thermodynamics. T. Yamaoka.** *Phys. Math. Soc. Japan, Proc.* 19. *pp.* 246–249, *March*, 1937.—*In German.* A simple derivation of the second law of thermodynamics, analogous to that of Planck [see Abstract 1821 (1927)], which clearly reveals the relations between the mathematical concepts and the physical quantities involved. R. W. P.

**2712. Equilibrium Diagrams of Helium-Nitrogen Mixtures. A. Fedoritenko and M. Ruhemann.** *Techn. Phys., U.S.S.R.* 4. 1. *pp.* 36–43, 1937. *In English.*—The *p-x*-diagrams of $He\text{-}N_2$ mixtures are determined between 5 and 150 atmos. and at the temperatures 64°, 78°, 90° and 108° K. T-x-curves are obtained for 4 and 20 atmos. With the help of the T-x-diagrams i-x-diagrams are computed for 4 and 20 atmos.
AUTHORS.

**2713. U-Effect of H. Amagat and P. Weiss. W. Jacyna.** *Zeits. f. Physik*, 105. 3–4. *pp.* 267–268, 1937.—This paper deals with a generalisation and extension of an earlier publication [see Abstract 5606 (1936)], and contains a solution of the author's partial differential equation, $\psi(\partial(\Delta v)/\partial\psi)_p - \Delta v = \phi(\psi, p)$, subscribed by R. O. Kuzmin, which, by means of the Lagrange method of variation of arbitrary constants, may be expressed in the explicit form, $\Delta v = \psi[\int\phi d\psi/\psi^2 + \Phi]$. H. H. Ho.

*__2714. Critical Temperatures of Individual Liquids and their Mixtures. W. Świętoslawski and S. Pieszczek.__* *Acad. Polonaise Sci. et Lettres, Bull.* 1–2*A*. *pp.* 72–80, *Jan.–Feb.*, 1937. *In English.*—A comparative method of measuring critical temperatures of liquid individual substances and mixtures is described. An apparatus suitable for simultaneous measurements of critical temperatures of several substances is described. A series of mixtures composed of $CS_2$ and acetone is examined by this method and the most probable composition of the azeotrope (72·1 % of acetone) at critical conditions is reported. It is shown that under these conditions the lowering of critical temperature is 3·2° C., when compared with that of acetone. When the critical temperature of acetone as a reference liquid is taken as 237·5° C., the critical temperature of the azeotropic mixture of $CS_2$ and acetone is equal to 234·3° C. AUTHORS.

**2715. Curvature of the Diameter of Densities. É. Mathias.** *Comptes Rendus*, 204. *pp*. 1097–1099, *April* 12, 1937.—Reference is made to the work of Young [see Abstract 2428 (1900)] carried out in connection with the law of rectilinear diameters discovered by Cailletet and Mathias. In addition to the two main conclusions reached by Young after studying 30 substances, *viz*. (*i*) that only for pentane and normal hexane is the diameter of densities truly a straight line, and (*ii*) that the curvature is in opposite directions as $\alpha T_c/d_c$ is greater or less than 0·93, it is now shown that the equations of the curves become identical when the variables *p*, *v* and T are replaced by their reduced values. R. W. P.

**2716. Free Energy of Diatomic Carbon Vapour. A. R. Gordon.** *J. Chem. Phys*. 5. *pp*. 350–352, *May*, 1937.—An equation for the rotational state sum for a $^3\Pi$ molecule with intermediate *a–b* coupling is derived from Budó's expression for the rotational energy, and is used to compute the free energy of diatomic carbon vapour. Previous calculations of the equilibrium between $C_2$ and C in the vapour are discussed, and a revised equation for the equilibrium constant is obtained. AUTHOR.

**2717. Internal Volume and Entropy of Vaporisation of Liquids. O. K. Rice.** *J. Chem. Phys*. 5. *pp*. 353–358, *May*, 1937.—An effective internal volume, $V_a$, of a liquid is defined by the equation $\Delta S = R\, ln\, V_g/V_a$, where $\Delta S$ = entropy of vaporisation, and $V_g$ =molal volume of the vapour in equilibrium. A condition for equilibrium is found which gives $\Delta S$ in terms of $V_a/V$ and $dV_a/dV$, where V is the actual molal volume of the liquid. The experimental data are considered in the light of this relationship, and the reason for the approximate validity of Trouton's or Hildebrand's rule is discussed. The nature of the relation between the internal and actual volume and its connection with the specific heat of the liquid is considered. Finally suggestions are made in way of explanation of the fact that entropies of vaporisation of associated liquids are practically invariably high. AUTHOR.

**2718. Theory of Phase Transformations. Part I. L. Landau.** *Phys. Zeits. d. Sowjetunion*, 11. 1. *pp*. 26–47, 1937. *In German*.—The problem of continuous phase charge, *i.e.* transformations without latent heat, has been investigated from the general thermodynamic standpoint. The transition between bodies of different symmetry (in particular between liquid and crystal) cannot proceed continuously in the same sense as that between liquid and gas at and above the critical point, since at any particular time the body must possess either the one or the other symmetry; nevertheless continuous changes of lattice symmetry are possible in the sense that no discontinuity in the state of the body occurs, and two types are distinguished and described, *viz.*: (1) At the Curie-point with a discontinuity of the specific heats which are found on one curve in the *p*, T-diagram, and (2) at isolated points in the *p*, T-diagram which lie at the points of intersection of the ordinary phase transformation curves. Continuous changes are also possible which are connected with the appearance or disappearance of the average magnetic moments in the atoms of crystals, *e.g.* at the Curie-points of ferromagnetic bodies as for case (1) above. H. H. Ho.

**2719. Phase Boundaries in Binary Alloys. Parts I and II. H. Jones.** *Phys. Soc., Proc*. 49. *pp*. 243–257, *May* 1, 1937.—In Part I the thermodynamic theory of the melting-point and freezing-point curves, in the $\alpha$ solid-solution region, of binary alloys is briefly considered. It is shown that the van 't Hoff relation should be applicable to these alloys, and its validity, for sufficiently dilute solutions is verified by comparison with experiment. It is shown from experiment that the change in the latent heat when small quantities of Ni, Zn, Ga or Ge are dissolved in Cu is proportional to the electron : atom ratio. Similar results are obtained for Cd, In or Sn dissolved in Ag. A qualitative theory is proposed to account for these effects. In Part II a quantitative theory of the phase boundaries in alloys between the face-centred and the body-centred cubic structures is given. The theory is applied in detail to alloys in which Cu is the major constituent. The width of the $(\alpha + \beta)$ mixed-crystal region is obtained with fair approximation; it is found that the width of this region decreases with increasing valency of the solute element, a result which is in accordance with experiment. The variation with temperature of the limits of the $\alpha$ and $\beta$ regions is obtained also; and again agreement with observations is fairly satisfactory. AUTHOR.

**2720. Entropies of n-Butane and Isobutane, with Heat Capacity Data for Isobutane. G. S. Parks, C. H. Shomate, W. D. Kennedy and B. L. Crawford, Jr.** *J. Chem. Phys.* 5. *pp.* 359–363, *May*, 1937.—The entropies of *n*-butane ($S_{298°} = 75 \cdot 8$ e.u.) and isobutane ($S_{298°} = 70 \cdot 0$ e.u.) have been calculated from thermal data by the third law of thermodynamics. In this connection, heat capacity data for isobutane over the temperature range 79°–261° K have been obtained by the Nernst method and also, as a partial basis for these calculations, the mode of extrapolating entropies below liquid air temperatures has been critically examined. The discrepancies between these new results and the corresponding entropies obtained by statistical methods appear too large to be accounted for by errors in the thermal data or extrapolations involved. The thermodynamics of the isomerisation reaction is briefly considered. AUTHORS.

**2721. Thermodynamic Study of Systems of Type $PbCl_2$—RCl—$H_2O$ at 25° C. E. R. Hounsell and H. N. Parton.** *Faraday Soc., Trans.* 33. *pp.* 629–633, *May*, 1937.—The activity coefficients of $PbCl_2$ in the presence of alkali chlorides are calculated from measurements of the e.m.f. of concentration cells. The results are compared with similar results in other systems. The possibility of complex ion formation is discussed. [See Abstracts 2192 (1935) and 1272 (1936).] AUTHORS.

**2722. Thermodynamics of an Activated Complex. E. A. Guggenheim.** *Faraday Soc., Trans.* 33. *pp.* 607–614, *May*, 1937.—The theory of reaction rates in gases due to Eyring and Polanyi and later generalised by Eyring [see Abstract 1206 (1935)] has been extended by them to reactions in solution and in their papers the theory has been clothed in quasi-thermodynamic form. Unfortunately the quasi-thermodynamic functions have in many cases been ambiguously defined, and this has led to controversy and confusion. For the purpose of the present paper the author has accepted Eyring's theory, while reserving criticism for another occasion, and now gives as briefly as possible what he believes to be the accurate thermodynamic relations, and in what respect they differ from those advanced by other authors. The confusion is found to arise largely although not entirely from the lack of sufficient care in defining standard states. The present paper considers thermodynamic definitions of ideal systems, homogeneous equilibria in ideal systems, transformation of formulæ for gases and for extremely dilute solutions, application to activated complex, dependence of activation energy on pressure, standard entropy differences, and entropy of activation. H. H. Ho.

**2723. Thermodynamics and the Velocity of Irreversible Processes. A. R. Ubbelohde.** *Faraday Soc., Trans.* 33. *pp.* 599–606, *May,* 1937.—A method is proposed for correlating the velocity of irreversible processes in a system with the thermodynamic functions of the system. In cases where the kinetic behaviour of the system can be summed up by the average fluctuations in its thermodynamic variables, and their time of relaxation, it is possible to reach conclusions about this kinetic behaviour with far less information about the system than when a complete statistical analysis is attempted. The examples adduced include a derivation of Ohm's law, of the equation for heat conduction, of the Wiedemann Franz law, and of equations for diffusion and viscosity. The velocity of these irreversible processes can thus be correlated with the thermodynamic functions of the system, which normally apply only to equilibrium processes. AUTHOR.

**2724. Mechanical Effects of Elastic Thermal Waves in Liquids. F. Perrin and R. Lucas.** *Comptes Rendus,* 204. *pp.* 960–961, *March* 22, 1937.—The existence of elastic thermal waves in a liquid has been demonstrated recently [see Abstract 1747 (1937)]. It is now shown that the pressure difference between two isothermal planes at heights $z_1$ and $z_2$ is given by $\int_{z_1}^{z_2} \rho g \, dz + (k/\phi)\{(\partial T/\partial z)z_2 - (\partial T/\partial z)z_1\}$ where $\rho$, $k$ and $\phi$ are respectively the specific gravity, thermal conductivity and a characteristic constant of the liquid, and $g$ is the gravitational acceleration. This expression is in agreement with the results of the earlier experiments.
R. W. P.

*See also* Abstracts 2339, 2770, 2776, 2815.

## VAPOUR PRESSURE.

**2725. Vapour Pressure of Binary Solutions of Isopropyl Alcohol and Benzene. A. L. Olsen and E. R. Washburn.** *J. Phys. Chem.* 41. *pp.* 457–462, *March,* 1937.—The differential static method devised by Parks is adapted for the measurement of the total and partial vapour pressures of the components of the binary solutions of isopropyl alcohol and benzene at 25° C. The accuracy of the method is discussed. These data are used to calculate the activity coefficients which indicate deviations from Raoult's law. Deviations from ideal behaviour are discussed and qualitatively explained on the basis of polarity. AUTHORS.

**2726. Vapour Pressure of Magnesium Bromide-Diethyl Ether Solutions. H. H. Rowley.** *Am. Chem. Soc., J.* 59. *pp.* 621–625, *April,* 1937.—The vapour pressure of diethyl ether saturated with $MgBr_2$ is measured over the temperature range from 0 to + 25°, and in more detail at 25° with variations in the ratio between $MgBr_2$ and ether from $\frac{1}{2}$ to 1. The presence of small amounts of moisture is found to alter greatly the vapour pressure of the system. This fact is advanced as a possible explanation for the low values reported in the literature by several authors.
AUTHOR.

**2727. Vapour Pressure of Cæsium by the Positive Ion Method. J. B. Taylor and I. Langmuir.** *Phys. Rev.* 51. *pp.* 753–760, *May* 1, 1937.—The positive ion currents from pure W filaments in saturated Cs vapour at bulb temperatures from − 35° C. to + 73° C. were measured for filament temperatures from 1000° to 1800° K. The results were corrected for the cooling effect of the leads and for photoelectric emission from the Cs film on the Pt deposited on the bulb which was used as an ion collector. The vapour pressures in mm. of Hg are given for solid Cs ($T < 302°K$) by $\log_{10} p_s = 10 \cdot 5460 - 1 \cdot 00 \log_{10} T - 4150/T$ and for liquid Cs ($T > 302°$ K.) by $\log_{10} p_L = 11 \cdot 0531 - 1 \cdot 35 \log_{10} T - 4041 - T$. The vapour pressures given by these equations are believed to be accurate to within 1 % from 220° to 350° K, within 3 % up to 600° and within about 8 % at 1000° K. AUTHORS.

**2728. Abnormal Vapour Pressures in KCl Solutions. H. N. Parton.** *Faraday Soc., Trans.* 33. *pp.* 617–623, *May*, 1937.—The activity of KCl is measured in its aqueous solutions from $0 \cdot 3M$ to $1 \cdot 2M$ by means of concentration cells without liquid junction. The vapour pressure of water over the solutions is calculated from the results. The vapour pressure of water in equilibrium with a number of KCl solutions is measured by two methods. The results of the above experiments are compared with previous work on the same solutions. AUTHOR.

**2729. Solubility Equation of Hydrates. J. Perreu.** *Comptes Rendus*, 204. *pp.* 1037–1039, *March* 31, 1937.—New determinations of the author combined with previous ones by others of the various quantities concerned for NaCl, $Na_2CO_3$ and $H_2C_2O_4 \cdot 2H_2O$ show that Perret's solubility equation is applicable in all three cases, and that Colson's deduction [see Abstract 136 (1916)] that the closely similar equation deduced by le Chatelier [see *Comptes Rendus*, 118. *p.* 638, 1894] does not apply, is incorrect. [See Abstract 3119 (1935).] C. A. S.

*See also* Abstracts 2714, 2860.

## ACOUSTICS.

**2730. Rayleigh Formula for Velocity Potential. N. W. McLachlan and A. T. McKay.** *Frank. Inst., J.* 223. *pp.* 501–509, *April*, 1937.—This paper is an answer to a statement by Ballantine [see Abstract 2903 (1936)] that the formula for velocity potential given by Rayleigh, cannot properly be used for calculating the radiation from a rigid disc in an infinite baffle. Calculation is made of the velocity potential due to a rigid flat disc in an infinite baffle and of the velocity potential on one side of a vibrating infinite plane, and it is concluded that Rayleigh's formula can quite properly be used. **S. Ballantine** (in reply) points out that this is true for a rigid *flat* disc and a plane baffle, but that for a curved disc and baffle the formula is inapplicable. J. E. R. C.

**2731. Motion of Particles in a Sound Field. O. Brandt, H. Freund and E. Hiedemann.** *Zeits. f. Physik,* 104. 7–8. *pp.* 511–533, 1937.—A theoretical and experimental study is made of the motion of particles in a sound field. The relation between the amplitudes of the particles and of the gas in which they are suspended is deduced and it appears that there is a limiting frequency, below which the particle or gas amplitudes are the same but above which the particle amplitude decreases, and finally, for high frequencies, becomes zero. The radius of the particle and the frequency are so related that for similar values of the expression $a^2\nu$ ($a$ = amplitude, $\nu$ = frequency) particles behave similarly. Photographs of the particle motion have been taken and good agreement with the above theoretical work is obtained. The fact that the gas and particle amplitude are different above the limiting frequency leads to calculable losses due to friction and the absorption of sound when passing through a dispersed system is calculated on this basis. The fact that above the limiting frequency particles having different radii also have different amplitudes leads to attractive forces between the particles. On this basis the coagulating effect of ultrasonic radiation is calculated. By observation of the light scattered from the particles it is shown that the sound causes them to orientate themselves in a manner depending upon their shape. J. E. R. C.

**2732. Absorption of Sound in Solids. L. Landau and G. Rumer.** *Phys. Zeits. d. Sowjetunion.* 11. 1. *pp.* 18–25, 1937. *In German.*—A theoretical investigation is made of the absorption of h.f. sound in a solid. The absorption is regarded as the result of an interaction between quanta of sound energy and of heat energy. On this basis it is deduced that the absorption coefficient should bear a linear relation to the frequency of the sound. J. E. R. C.

**2733. Absorption of Sound by Crystals at High Temperatures. A. S. Kompaneietz.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 14. 5. *pp.* 267–270, 1937. *In French.*—Mathematical. The proper oscillations of the atoms which constitute the crystals can be resolved into plane progressive waves, each of which is determined by a wave-vector and the frequency. An expression for the coefficient of extinction is derived which is proportional to the absolute temperature. The result is applied to the propagation of an impulse along a semi-infinite unidimensional rod. G. E. A.

**2734. Relation Between the Dust Figures Observed on Rectangular and Square Plates. B. Pavlík.** *Ann. d. Physik,* 28. 7. *pp.* 632–648, *April,* 1937.—A theoretical and experimental study is made of the dust figures obtainable upon square and rectangular plates. It is shown that Goldmann's application of Ritz's method [*Diss., Breslau,* 1918] is incorrect. To a first approximation the patterns on a rectangular plate are composed of lines parallel to the edges. In general the patterns upon such a plate are not similar to those obtainable upon a square plate. Experiments have been made to test this point with a plate driven by magnetostrictive action and good agreement is obtained. Photographs showing the transition from a rectangular to a square plate are reproduced for a number of frequencies. J. E. R. C.

**2735. Acoustics of Wind Instruments. K. Struve.** *Techn. Phys., U.S.S.R.* 3. 12. *pp.* 1044–1055, 1936. *In German.*—A theoretical treatment of brass and wood-wind instruments based upon the use of Webster's acoustic impedance idea. Experimental measurements of the impedance of a number of horns are reported and the results can be used to reduce the amount of trial and error work necessary in modifying the design of actual instruments. W. H. G.

**2736. Frequencies of Sounds Given by a Cylindrical Tube with Vibrating Reed. L. Auger.** *Comptes Rendus,* 204. *pp.* 1169–1171, *April* 19, 1937.—The reed used was of hard brass, of dimensions 40 × 8 × 0·4 mm. This was mounted, by means of a lead plug, at one end of a brass tube of 45 mm. dia. whose length could be varied from a few cm. to 130 cm. The natural frequency of the damped oscillations of the reed was 170, but when mounted and fed by an air current under a pressure of 8 cm. of water the frequency of the sustained oscillations of the reed was 200. As the length of the brass tube was increased from 0 to about 42 cm. the frequency fell from 200 to 172, the tube vibrated and the sound exhibited intensity variations like an organ tremolo. When the length reached 42 cm. the tube vibration became more and more rapid and the frequency suddenly jumped to 200. So long as the length was between 42 and 50 cm. the sound emitted was round, intense and of good quality, the frequency gradually falling to 170 as the length increased to 50 cm. With further increase of the tube length the frequency jumped suddenly to 200 again, after which the frequency fell, with two smaller frequency jumps at tube lengths of about 68 cm. and 107 cm. respectively. The natural frequency of a tube of length 50 cm., closed at one end, is 170. A. W.

**2737. Coupling in String Instruments. H. Backhaus.** *Zeits. f. techn. Physik,* 18. 4. *pp.* 98–103, 1937.—An experimental study of the smoothing effect of the instrument upon the initial conditions by which the sound is generated and of the general damping. From vibration records the coupling between string and sound-board is studied for violins. The coupling diminishes from the *g* to the *e* string and, in general, is tighter for good violins than for ordinary instruments. W. H. G.

**2738. Pianoforte Strings. O. Vierling.** *Zeits. f. techn. Physik,* 18. 4. *pp.* 103–105, 1937.—An experimental study of the vibration of pianoforte strings especially in relation to their mutual couplings and to their coupling through the bridges to the soundboard. For large amplitudes of vibration of the string tilting of the bridges is necessary for small damping due to frictional forces. For higher frequency sounds, amplitudes, for a given intensity, will be less than for sounds of lower frequency. Many notes of the pianoforte have three strings tuned as nearly as possible to unison. In practice the unison is only approximate and the initial falling off of the sound is due less to frictional forces depending on amplitude, than to the phase differences of the vibrations of the three strings, depending on their lack of unison. W. H. G.

**2739. Equal Temperament Tuning of Keyboard Instruments. G. F. H. Harker.** *Acoustical Soc. of America, J.* 8. *pp.* 243–256, *April*, 1937.—A general summary of the principles underlying the practical tuning of keyboard instruments to equal temperament. There are a number of references to tests, published elsewhere, made upon instruments tuned by practical tuners. Intervals including octaves may be out of tune by one-fifth of a semitone. Key colour is discussed with the aid of some striking examples of the practice of Schubert and other famous composers who apparently treated transposition with indifference, contrary to the pronounced preferences of other composers who claim to be affected by the phenomenon of key-colour. W. H. G.

**2740. Vibrations of the Violin Bridge. M. Minnaert and C. C. Vlam.** *Physica*, 4. *pp.* 361–372, *May*, 1937. *In English.*—Deals with a detailed experimental study of the vibrations of the bridge of a violin. The nature of the vibrations appears to depend more on the frequency of the sound than upon the particular string bowed. A change of one semitone makes a great difference in the form of the curves. A considerable change of tone quality, as by using a mute, was necessary to alter the curves for a given fundamental frequency. Strong bowing increases the amplitude of the vibration curves but changes their character only slightly. Bowing upwards gives inverted but otherwise similar curves to bowing downwards. Only for some particular notes is the frequency of transverse vibrations of the bridge double that of the string. The resonances with the characteristic vibrations of the different parts of the whole instrument play by far the chief role. The original paper gives many details of deformations of the bridge, the influence of modifying it and of the mute. On account of the cuts in the bridge, vibrations in its plane only are transmitted to the belly of the instrument. W. H. G.

**2741. Influence of Wind on Propagation of Loud Sounds. P. C. Moles.** *Soc. Belge Élect., Bull.* 53. *pp.* 237–240, *March*, 1937.—Deals with the propagation of sounds from high power loud-speakers such as might be used for giving warning signals over a wide area. In calm air the frequency range 1500-2500 is propagated best, a range of about 1500 m. being obtained from a 60-W output. The acoustic efficiency of an ordinary loud-speaker is given as about 0·03%. The results for the influence of wind are given in the form of an empirical formula involving the velocity gradient (with height above the ground) of the wind. W. H. G.

**2742. Influence of Temperature on the Absorption of Ultrasonic Waves in Benzene and Carbon Tetrachloride. P. Bažulin.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 14. 5. *pp.* 273–274, 1937. *In French.*—Continuation of a previous paper [see Abstract 5130 (1935)], describing further experiments carried out by the same method, at temperatures 18–76° C. The measurements were made at the frequency $\nu = 11.470$ kc. for the two liquids. The coefficient of absorption $\alpha$ is proportional to the square of the frequency in the region of frequency 5000–11,500 kc. In benzene the coefficient $\alpha$ varies from $1 \cdot 15 \pm 0 \cdot 02$ to $1 \cdot 52 \pm 0 \cdot 05$. An increase of $\alpha$ occurs near the boiling point, but if the liquid is first heated to the b.p. and then gradually cooled this increase disappears in the measurements during cooling. This is probably due to the disengagement of the gas in the form of little bubbles, leading to absorption of ultrasonic waves due to friction between the liquid and the bubbles. In the case of $CCl_4$ $\alpha$ varies from $0 \cdot 73 \pm 0 \cdot 63$ at 17° C. to $0 \cdot 82 \pm 0 \cdot 06$ at 76° C. J. J. S.

**2743. Diffraction of Light by Ultrasonic Waves. Part I. Narrow Beam of Light. Part II. Oblique Incidence. O. Nomoto.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 255–270, *March,* 1397. *In German.*—The diffraction spectra obtained with stationary and progressive ultrasonic waves are independent of the breadth of the beam. In general, a breadth of two to three sound wave-lengths is sufficient for the production of the spectra with stationary ultrasonic waves ; and the spectra are quite distinct when a breadth of one wave-length is used with progressive waves. The intensity distribution of the light is also independent of the breadth of the light beam. In Part II chiefly stationary waves were used. The spectra are asymmetric as regards intensity distribution when the angles of incidence are small, but are symmetrical, although with a diminished number of lines, when the angle of incidence is large. The results, at first unexpected, are explainable on the Raman-Nath theory. Many reproductions of spectra are given. G. E. A.

***2744. Magnetostrictive Under-Water Sound Receivers. T. Kuyama.** *Phys. Math. Soc., Japan, Proc.* 19. *pp.* 250–254, *March,* 1937. *In German.*—The length of a metal rod for a given frequency may be reduced by reducing the diameter of a central section, thereby forming a rod with loaded ends. In this way the difficulty of using long rods as sound oscillators is avoided. The author applies the principle in the construction of small magnetostrictive sound receivers of Ni—of frequencies 37, 22 and 8 kc./sec. With these receivers under water he obtains the frequency characteristics of various sources of sound over a frequency range 0 to 3000∼. A. B. W.

**2745. Frequency and Decrement of Resonant Vibrations of the Mouth Cavity in Vowel Sounds. W. Trendelenburg.** *Preuss. Akad. Wiss. Berlin, Ber. Nos.* 22–23. *pp.* 308–321, 1936.—The resonant vibrations of the mouth cavity were investigated with reference to frequency and logarithmic decrement. Excitation of the cavity was effected by the bursting of a liquid membrane, by the rapid opening of the mouth by motion of the lips or jaws, and by snapping the fingers. The frequencies found for the vowels agree, in general, among themselves, and also with the values found, for the same person, from curves for whispered vowels. It is shown that the magnitude of the decrement increases as the size of the mouth opening diminishes (0·17 for *ah*, 0·10 for *oh*). Also for a given mouth setting the damping is greater with an open throat than when the tongue is in contact with the soft palate (0·37 as against 0·25 for *oo*). A knowledge of the decrements is of importance in the question of the reaction of the cavity on the vibrations in the larynx. G. E. A.

**2746. Physiological Investigations on Voice Production. Part II. W. Trendelenburg.** *Preuss. Akad. Wiss. Berlin, Ber. Nos.* 22–23. *pp.* 338–364, 1936.—Records were taken of vibrations of the crown of the head and of the cheeks. The sounds *m* and *n* (with nose closed) gave records which indicate plainly the difference between the high formants for these two sounds. There is, in vowel curves, a group of vibrations, the "starting group," which coincides in time with the opening of the glottis. There is probably also a similar group associated with the closing of the glottis. With a sharply aspirated vowel such as *ha*, the position of the transition from *h* to the beginning of the first vibration of *ah* corresponds exactly to the position of the later beginning of the starting group. The "shock of the glottis" of the theory of singing is discussed. The glottis shock is not connected with any special process which precedes the opening of the glottis, it is simply a sudden beginning of the vibrations. [See also Abstract 3781 (1936).] G. E. A.

***2747. Microphone-Actuated Thyratron Relay. C. V. Rajam.** *Indian Acad. Sci., Proc.* 5*A. pp.* 301–304, *March*, 1937.—The thyratron used as a sensitive relay can be actuated by a microphone directly coupled to the grid. The grid is given a suitable negative bias controlled by a potentiometer and coupled to a sensitive carbon microphone through a high ratio step-up transformer. The negative bias is adjusted so as just to prevent the thyratron striking and actuating the load circuit when no sound is incident on the microphone. When a sound is incident on the microphone the stepped-up alternating potential induced in the secondary of the transformer momentarily reduces the negative bias on the grid and the thyratron strikes to actuate the load. The sensitivity can be controlled very effectively to a definite minimum sound intensity below which the relay will not respond. Applications to sound intensity and other electro-acoustic measurements are discussed. W. H. G.

***2748. Infrasonic Radiator. L. Mjasnikov.** *Techn. Phys., U.S.S.R.* 4. 1. *pp.* 83–87, 1937. *In English.*—A radiator-rotor of simple construction for frequencies from 8 to 35∼ is described and its theory is given. The construction of a pulsating sphere is given and certain measurements in an infrasonic enclosure with the aid of a resonance receiver and oscillograph are described. AUTHOR.

*See also* Abstracts 2319, 2551, 2856.

# ELECTRICITY AND MAGNETISM.

## ALTERNATING-CURRENT NETWORKS.

*See* Abstract 2786.

## CONDUCTION AND DISCHARGE IN GASES.

**2749. Theory of Corona Discharge. N. Kapzov.** *Phys. Zeits. d. Sowjetunion,* 11. 1. *pp.* 95–117, 1937. *In German.*—Following an idea of Rogowski, the field distribution is investigated quantitatively. It is found that the assumption, which is usually made, that the layer in which the ions are generated, is of negligible thickness and contains a negligible part of the total potential drop, is not correct. A more correct treatment shows that the field in this layer is almost identical with the statical field corresponding to the initial potential. The formulæ obtained by several other authors are criticised and a very exact treatment is given. For most practical purposes this may be replaced by a more approximate, but simpler formula. The discrepancies in the values of the ion mobilities as derived by various observers from their experiments must be due to their using different inadmissible approximations. R. P.

**2750. Effect of Air Velocity on the Spark Between Point-Plate and Two-Point Electrode Systems. E. L. E. Wheatcroft, R. B. Smith and E. L. Hoyle.** *Phil. Mag.* 23. *pp.* 718–726, *April,* 1937, *Supplement.*—Gives results of an experimental investigation into the action of an air-blast on the breakdown between point-plate and two-point electrodes, the blast being emitted from the point electrode. The effect on the behaviour of the point-plate rectifier is also examined. It is concluded that air flow has little effect on the sparkover voltage, and, therefore, in the rectifier the action of the air-blast is that of scavenging, as in the case of an air-blast circuit-breaker. E. O. T.

**2751. Gradient of Extra-High-Pressure Mercury Discharge. W. Elenbaas.** *Physica,* 4. *pp.* 279–284, *April,* 1937. *In German.*—The gradient in the e.h.p. Hg discharge is greater than would be expected from measurements of and formulæ for the gradient in the one-atmosphere type [see Abstract 4316 (1936)]. A diagram is given showing the factor by which the gradient calculated from the formula $G_m = 370m^{7/12}\,d^{-3/2}$ must be multiplied to obtain results corresponding with the observed values, $m$ here being the quantity of Hg vapour per cm. length (mg./cm.) and $d$ the diameter of the column in mm. Some possible causes of the observed higher gradients are discussed. A. W.

**2752. H.F. Discharge in Helium. J. Roig.** *Comptes Rendus,* 204. *pp.* 961–964, *March* 22, 1937.—Observations were made on the grid and anode currents in the valves of a h.f. oscillator by which a He tube was excited. The currents increase linearly as the anode voltage is increased; the intensity of the discharge increases with the currents, but it is weak and the tube has only a slight reaction on the circuit. As the voltage increases over 1050 V the grid current steadily falls and the anode current rises more rapidly, after a transition period covering about 150 V; the intensity becomes much higher and increases linearly with the voltage. Below the transition stage the discharge is of the " electrostatic " type; above, it is of the " induced " type. D. H. F.

**2753. Sparking Potential Curves in Ionisation by Collisions of the Second Kind. R. Zouckermann.** *Comptes Rendus*, 204. *pp.* 964–966, *March* 22, 1937.—Sparking potential in A and $N_2$, both pure and containing Hg vapour, was plotted against pressure, for pressures ≯ 0·4 mm. Hg. The curves generally resemble those previously obtained with $H_2$ [see Abstract 5144 (1935)], save for the absence of inflexion ; but in A Hg markedly diminishes the potential, to an extent increasing with pressure, as is to be expected in the case of collisions of the second kind ; a result which favours the view that metastable atoms intervene. The spectrum of $N_2$ with or without Hg, contained no lines of atomic, but only of molecular $N_2$, thus differing from that of $H_2$ which always showed both. C. A. S.

**2754. Measurement of Power Dissipated at the Walls of the Positive Column. B. Klarfeld.** *Techn. Phys., U.S.S.R.* 4. 1. *pp.* 44–67, 1937. *In English.*—The power released at the walls of discharges in Hg vapour was measured by the probe method. At a pressure of 0·00022 mm. Hg, this power was 86% of the total power expended in the positive column. An increase in pressure causes a decrease in this percentage along a complicated curve. Increase of the discharge current is accompanied by increased losses at the walls. An explanation is given of the relationships determined. Measurements were also made of the electron temperature, electron concentration and potential gradient, over a wide range of pressure and current values. Approximate calculations show that at pressures of $10^{-4}$ to $10^{-3}$ mm. Hg, about 4 to 7% of the total power losses in the discharge are due to collisions of excited atoms with the walls. . Thermal losses in the volume of the gas, due to elastic collisions of electrons, were measured to the limiting pressures at which probe measurements are still applicable, and it was found by extrapolation that at pressures of about 1 mm. Hg these losses attain 5% of the total discharge losses. Careful measurements with a plane probe at the wall gave evidence of a deficit of fast electrons in the Maxwellian velocity distribution in the positive column. A. W.

**2755. Influence of Cd Vapour on the Sparking Discharge Potential in Argon. I. Kesaev.** *Techn. Phys., U.S.S.R.* 4. 1. *pp.* 68–72, 1937. *In English.*—Penning has studied in detail the effect on the sparking discharge potential of inert gases of admixtures of A, Kr, Hg, etc. [See Abstract 3855 (1934).] Some admixtures lowered the potential considerably even when added in minute quantities and the lowering was always found when the ionisation potential of the admixture was lower than the excitation potential of a metastable state of the principal gas. Measurements are here described of the lowering of the sparking discharge potential of A by admixture of Cd vapour. Special care was taken to purify the A before any measurements were made. The curves given show a discernible reduction in the sparking potential for an admixture of Cd vapour of only 0·002%. The sparking potential reaches a minimum of 222 V when the Cd content is 0·5%. The most probable value of the sparking potential for pure A appears to be 362 V at room-temperature. A. W.

**2756. Normal Kathode Fall at Single Crystal Surfaces of Different Orientation. Part I. H. Kurzke.** *Zeits. f. Physik*, 104. 11–12, *pp.* 735–743, 1937.—Using various methods it is observed that the normal kathode fall depends on the orientation of the single crystal surface. The difference between the kathode fall at the (111) plane and the $(11\bar{1})$ plane of a Bi single crystal amounts to about 3 to 4 volts. The chief cleavage plane has the lower kathode fall. J. J. S.

**2757. Dissociation Energy of CO. M. de Hemptinne, J. Savard and P. Capron.** *Comptes Rendus,* 204. *pp.* 1039–1041, *March* 31, 1937.—Critical potentials previously reported [see Abstract 1326 (1937)] are extended by the determination of 29 further critical points in the range 19·2–26·8 eV. The general characteristics and the interpretation of these points is discussed, and the evidence strongly indicates that the 20 eV point represents the dissociation $CO = C^+(^2P) + O(^3P)$. N. M. B.

*** 2758. Construction and Operation of a Cyclotron to Produce $10^6$V-Deuterons. P. G. Kruger and G. K. Green.** *Phys. Rev.* 51. *pp.* 699–705, *May* 1, 1937.—A cyclotron for producing $10^6$V-deuterons is described. The general magnetic field characteristics, and the effect of shims on the magnetic field have been examined. The production of ions for acceleration with and without filaments is discussed. The operation with a continuous glow discharge in the vacuum chamber is possible only because a transmission line is used to feed power to the dees. Various construction and operation details are given. The cyclotron has been found very reliable in operation and a maximum ion beam of 11 μA has been maintained for long periods of time. The beam has been removed in vacuum to a point about four feet from the vacuum chamber and partially focused. This allows bombardment work to be done with little interference from background radiation and high intensity fields.

AUTHORS.

*See also* Abstracts 2494, 2645, 2836, 2846.

## CONDUCTION IN SOLIDS AND LIQUIDS.

**2759. Theory of Solids. Part III. F. Seitz and R. P. Johnson.** *J. of Applied Physics,* 8. *pp.* 246–260, *April,* 1937.—This article deals with the properties of the solid surface, and with the influence of impurities and flaws on certain volume characteristics. There has been very little theoretical work in these fields on the basis of the modern views. Consequently, a considerable part of the paper is more or less speculative. [For Part II see Abstract 2216 (1937).]

**2760. Mean Free Path of Electrons in Pb and Cd. L. Riedel.** *Ann. d. Physik,* 28. 7. *pp.* 603–631, *April,* 1937.—Measurements are made of the resistance of thin wires of Pb and Cd at low temperatures. The values obtained for the mean free paths at 0° C. are 63 Å for Pb, and 292 Å for Cd. Assuming the validity of the Sommerfeld-Bethe formula for conductivity, the number of free electrons per atom is calculated as being between 1/3 and 1. The former figure agrees with Mott's calculations. J. E. R. C.

***2761. Amplification of Galvanometer Deflections. A. H. Taylor.** *Rev. Sci. Instruments,* 8. *pp.* 124–125, *April,* 1937.—A convenient arrangement of primary galvanometer, optical system, photoelectric relay, and secondary galvanometer for high sensitivity in d.c. work. The primary galvanometer, lamp, lenses, photo-cells and batteries are compactly mounted in a box, which is weighted and supported on rubber balls to minimise vibration. The secondary galvanometer is of normal design but is used with a large scale-distance. The chief advantages claimed are simplicity of construction and operation, combined with a sensitivity which is limited only by the stability of the primary galvanometer. L. H.

***2762. Modified Potentiometer for Measuring Very Small Resistances. P. Kapitza and C. J. Milner.** *Journ. Sci. Instruments*, 14. *pp.* 165–166, *May*, 1937.—Two changes in the circuit arrangement of a potentiometer as used for resistance measurements were found to reduce considerably troubles due to "residual e.m.f." The changes were: (1) breaking both battery circuits, instead of the galvanometer circuit, to test for balance; (2) making reduction of the battery voltage by a fixed voltage divider follow, instead of precede, that by the potentiometer box itself. Some points of practical significance are discussed. AUTHORS.

**2763. Effect of Stretching on Electrical Conductivity of Metals. E. Lopukhin.** *Techn. Phys., U.S.S.R.* 4. 1. *pp.* 25–35, 1937. *In German.*—The specific resistance in the elastic and inelastic regions of steels of varying C content, of alloy steels, of Cu, Al, Zn, brass and bronze is measured on extension. For all the specimens examined, the specific resistance increases with an increase in foreign elements (independently of their particular resistivities) in agreement with Mathiessen's rule. In the elastic region the values of $\Delta r/rp$ and $\Delta\rho/\rho p$ are positive and are of the order given by Bridgman's formula; $\Delta\rho/\rho p = \Delta r/rp - (1 + 2\mu)/E$ where $p = kg./cm.$, $\mu$ = Poisson's ratio and E = elasticity modulus. In the inelastic region $\Delta r$ is always positive; $\Delta\rho$ is positive for steels up to 0·7 % C, Al and Zn but is negative for high C and alloy steels, Cu, brass and bronze. The values of $\Delta r/r$ and $\Delta\rho/\rho$ for all types of steel are considerably larger in the elastic region than in the inelastic (for the same deformation). It is thus possible to determine the elastic limits (to about 5 %) of the material by noting when $\Delta r/r$ suddenly changes its value. H. J. H. S.

**2764. Unipolar Electric Conduction of Carborundum. M. K. Chakravarty and S. R. Khastgir.** *Zeits. f. Physik*, 105. 1–2. *pp.* 88–91, 1937.—The existence of a unipolar conduction in carborundum is found experimentally by showing that the potential drop in a crystal depends on the direction of the current. Iron pyrites, galena and magnetite show no such effect. [See also Abstract 2693 (1935).] H. J. H. S.

**2765. Volume Rectifying Effect in Illuminated $Cu_2O$ Crystal. G. Groetzinger and J. Lichtschein.** *Phys. Zeits.* 38. *pp.* 292–298, *April* 15, 1937.—It is found that natural $Cu_2O$ crystals, which show the Dember effect, exhibit rectifying properties when illuminated. It is shown that the effect does not occur at the electrodes, but, like the Dember effect, in the body of the crystal. If the spectral composition of the light is altered so as to reverse the sign of the Dember effect, the direction of the rectifying action also alters. In artificial $Cu_2O$ crystals, which do not show the Dember effect, this rectifying effect is absent. D. H. F.

**2766. Theory of Supraconductivity. L. Landau.** *Phys. Zeits. d. Sowjetunion*, 11. 2. *pp.* 129–140, 1937. *In German.*—If a certain magnetic flux is forced through a supraconducting slab, the interior splits up into regions in which supraconductivity has been destroyed and in which therefore the field is equal to the threshold value, and other regions that are still supraconducting. The shape of the boundaries between these regions is calculated and an estimate of their thickness is made. R. P.

**2767. Structure of Electrons and Supraconductivity. J. Stark.** *Phys. Zeits.* 38. *pp.* 269–277, *April* 15, 1937. *From the Reichsanstalt.*—In continuance of an idea suggested in an earlier paper [see Abstract 4356 (1935)] conducting electrons are considered to have an axial structure. In the normal conducting state thermal agitation ensures that the axes of the free electrons are completely disordered and still remain so in the presence of the induced magnetic field. At low temperatures the thermal disturbances weaken, and when certain conditions are fulfilled, this imposed field causes the electrons to set in one direction. These conditions for the axial setting of the free electromagnets are only possible for certain metals at temperatures immediately above the absolute zero, and then supraconductivity results. By further assuming the electron to be of a ring form the superimposed magnetic field can also cause a diamagnetic induction of current in the supraconducting electron ring, the moment of which is opposed to the paramagnetic moment of the "set" electron. This presence of both paramagnetic and diamagnetic induction in the electromagnets of a supraconductor leads to complicated phenomena. When the diamagnetism is strong enough to outweigh the paramagnetism completely the supraconducting body appears as a diamagnetic body of susceptibility $-1/4\pi$ (Meissner-Ochsenfeld effect). [See following Abstract.] R. W. P.

**2768. Magnetic Induction in Supraconductors. J. Stark and K. Steiner.** *Phys. Zeits.* 38. *pp.* 277–283, *April* 15, 1937. *From the Reichsanstalt.*—A systematic series of measurements is carried out to determine the magnetic induction just above and below the supraconducting point, and on rapid transition from one state to the other. The specimens employed are a cylindrical rod of tin, a Sn-Cd alloy containing 1 % Cd, and a tubular single crystal of Sn. The results obtained for the ballistic throw due to change in induction on passing through the transition region can be explained as due to two opposing effects such as paramagnetic alignment and diamagnetic induction [see preceding Abstract]. The experiments enable the magnitudes of the separate effects to be determined, and it is seen that the paramagnetism increases towards a saturation value as the field strength is increased, which is greater the greater the distortion in the structure of the original metal. R. W. P.

**2769. Supraconducting Cylinders. D. Shoenberg.** *Cambridge Phil. Soc., Proc.* 33. *pp.* 260–276, *April*, 1937.—The magnetisation curves of short Sn, Pb and Ta cylinders are measured by the force method, and it is shown that although for Sn there is no appreciable hysteresis in the transverse position, there is a very marked hysteresis in the longitudinal position, of the same form at different temperatures but depending on the sharpness of the cylinder rims. Pb and Ta show additional temperature-dependent features which can be attributed to impurities. The hysteresis due to shape in the longitudinal cylinder is analogous to the hysteresis of alloy ellipsoids, in that the magnetisation for a given field always lies within a certain boundary curve and varies "classically" within this boundary. This analogy suggests that the mechanism of the shape hysteresis for a pure supraconductor may be similar to the sponge mechanism proposed by Mendelssohn for alloys, but it is also possible that the hysteresis is due to the formation of macroscopic supraconducting rings. The considerations which fix the boundary curve are probably similar to those in the supraconducting ring, and in this connection some new measurements on a Pb ring are preported. The paper concludes with a discussion of the time lag between magnetisation and field, and it is suggested that this is not a primary phenomenon. AUTHOR.

**2770. Equilibrium Curve and Entropy Difference between the Supraconductive and the Normal State in Pb, Hg, Sn, Ta and Nb. J. G. Daunt and K. Mendelssohn.** *Roy. Soc., Proc.* 160*A*. *pp.* 127–136, *May* 1, 1937.—The curves in the (*H*, *T*) diagram showing the equilibrium between the supraconductive and the normal state are determined for Pb, Hg, Sn, Ta, and Nb from measurements of the magnetic induction. The entropy differences between the two states are calculated and the following conclusions are drawn: (1) that the electronic entropies of non-supraconductive Pb and Hg are considerably higher than those given by Sommerfeld's formula on the assumption that the number of free electrons is equal to the valency, (2) that in Ta and Nb not only the valency electrons but also the electrons in the partly unfilled lower shell take part in the formation of the supraconductive state. The difference in specific heat between the two states is calculated for Hg and Ta. AUTHORS.

**2771. Conductivity and Viscosity of Alcohols. P. P. Kobeko, E. V. Kuvshinski, F. A. Gorodezkaja, I. P. Bachaev and S. G. Zhitnikov.** *Acta Physicochimica*, 6. 2. *pp.* 239–254, 1937. *In English.*—The electrical conductivities and viscosities of ethyl, propyl, isobutyl and isoamyl alcohols and glycerin were determined at various concentrations, 0·15, 1·0 and 5·0 %. The measurements were continued with solutions of HCl in isoamyl alcohol. The results showed that Walden's law holds for simple alcohols, glycerin and solutions of HCl over a very large temperature range. F. J. B.

**2772. Conductivity of KCl Solutions. C. W. Davies.** *Chem. Soc., J. pp.* 432–436, *March*, 1937.—The sources of error in conductivity measurements due to faulty cell design and inadequate earthing arrangements, recently discussed by Grinnell, Jones and others, have been examined experimentally, and are not considered to have caused serious errors in the past. On the other hand, serious polarisation errors are to be anticipated when a cell containing greyed electrodes is used outside a very restricted concentration range. The equation proposed by Shedlovsky for dilute KCl solutions is criticised. A modified equation, leading to a higher $\Lambda_0$ value, is proposed. New measurements on KCl at 25° are in agreement with Shedlovsky's figures, and, combined with new figures at 18°, lead to the conclusion that conductivities based on the Kohlrausch standard are 0·07 % higher than those based on the new standard of Jones and Bradshaw. AUTHOR.

**2773. Conductance of Kohlrausch's Standard KCl Solutions in Absolute Units. G. Jones and M. J. Prendergast.** *Am. Chem. Soc., J.* 59. *pp.* 731–736, *April*, 1937.—The absolute specific conductances of the 1, 0·1 and 0·01 *N* KCl solutions recommended by Kohlrausch as a standard of reference for conductivity measurements are redetermined. The results indicate that the corrections used by the " International Critical Tables " in the recalculation of the conductance data are unreliable. AUTHORS.

**2774. Conductivity of Univalent Electrolytes in Water. R. A. Robinson and C. W. Davies.** *Chem. Soc., J. pp.* 574–577, *April*, 1937.—It is shown that the change of conductivity with concentration in the case of LiCl, NaCl, KCl and HCl at 25° can be expressed within the experimental error by: (1) Onsager's limiting equation up to 0·001*N*, (2) the equation $\Lambda = \Lambda_0 - b(\sqrt{C} - C + 0{\cdot}001)$ between 0·002 and 0·02*N*, and (3) the equation $\Lambda = \Lambda_0 - b.f(C)$ above 0·02*N*, $f(C)$ being an empirical function of the concentration and the same for all electrolytes. The data for $KNO_3$ and $AgNO_3$ are anomalous but can be accounted for by assuming incomplete dissociation, *K* being 1·6 and 1·5 respectively at 25° compared with 1·3 and 1·2 at 18°. The conductivities of solutions of $TlClO_4$ and

TlOAc have been measured at 25° up to a concentration of $0 \cdot 01N$, and the dissociation constants of a number of thallous salts have been calculated. AUTHORS.

**2775. Conductivity of Aqueous Solutions of Rare-Earth Halides. G. Jantsch, H. Grubitsch and E. Lischka.** *Zeits. f. Elektrochem*, 43. *pp.* 293–296, *May*, 1937.—Electrolytic conductivities are determined for solutions of the pure trivalent chlorides, bromides and iodides of a number of rare earth elements at 0° and 25° C. The hydrolysis of these salts is very small even at dilutions down to 2048 l. From conductivity measurements on solutions of the divalent halides of europium, ytterbium and samarium at successive times after making up, it is concluded that the stability towards water decreases in the order given. L. A. W.

*See also* Abstracts 2335, 2341, 2342, 2723, 2837, 2846, 2854, 2865.

## DIELECTRICS AND CAPACITANCE.

**2776. Electrolytic Conductivity and Thermodynamics of Intermediate Reactions. H. Schmid, R. Marchgraber and F. Dunkl.** *Zeits. f. Elektrochem.* 43. *pp.* 337–340, *May*, 1937.—Methods of using measurements of the electrical conductivities of solutions as an auxiliary to the investigation of the thermodynamics of intermediate reactions are developed. The details of the measurements and apparatus are described for reactions taking place in streaming electrolytes. The accuracy of the method is proved by application to the case of $HNO_3$ at 25° C. was found to be $5 \cdot 1 \times 10^{-4}$. This value is in good agreement with the value obtained by other methods. F. J. B.

**2777. Structure of Dipole Liquids. J. Malsch.** *Ann. d. Physik*, 29. 1. *pp.* 48–60, *May*, 1937.—The present theoretical investigation has not only confirmed previous experimental work but has furnished quantitative data with respect to the structure of dipole liquids. Phenomena at low field strengths (molecular polarisation) are first considered, then the behaviour in strong fields (dielectric saturation) is dealt with, following which comes a discussion of anomalous dispersion and absorption with a necessary extension of previous theory. H. H. Ho.

**2778. H. F. Permittivity and Power Factor of Glasses. W. Hackel.** *Ann. d. Physik*, 29. 1. *pp.* 63–80, *May*, 1937.—Measurements have been made on a number of glasses at wave-lengths from 12,000 m. to 10 m. The specimens were placed in a vessel containing liquids whose permittivity and power factor could be varied until the insertion of the specimens produced no change of capacitance or conductance. The measurements were made by a barretter method. The permittivity and power factor of glasses of widely different compositions were found to vary little with frequency in the range of wave-length from 12000 m. to 10 m. W. H. W.

**2779. Dielectric Constant of Ionised Gases. A. Iman and S. R. Khastgir.** *Indian Journ. Phys.* 11. *pp.* 37–48, *Feb.*, 1937. *Phil. Mag.* 23. *pp.* 858–865, *May*, 1937.—Measurements of dielectric constants of some ionised gases ($Cl_2$, $Br_2$, $I_2$, and Tl vapour) have been made, avoiding the formation of ionic sheaths. The dielectric constant has always been found to be less than unity. In the case of the $Cl_2$ and Tl tubes the reduction in the value of the dielectric constant has been found to increase approximately proportionately with the increase of the discharge current, thus furnishing experimental evidence of the Eccles-Larmor theory. In the case of the $I_2$ tube, however, the change in the dielectric constant has been found to be practically independent of the discharge current. When the wave-length has been changed, keeping the tube current constant, the dielectric constant of the ionised gas has been found to decrease almost proportionately with the square of the wave-length up to a certain wave-length, thus showing agreement with the Eccles-Larmor formula up to that point. Beyond this wave-length the dielectric constant has been found to increase. Some kind of resonance effect has been suggested to explain this experimental result. AUTHORS.

**2780. Rotation Dispersion of Isohydrobenzoin and the Dipole Moments of Isohydrobenzoin and Benzoin. F. Eisenlohr and L. Hill.** *Zeits. f. phys. Chem.* 36. *Abt. B.* 1. *pp.* 30–44, 1937.—It is shown that no indication of anomalous rotation dispersion may be found in the visible part of the spectrum either on the dispersion curves of the right or of the left forms. These facts are established for the temperature range of 20° to 50° C. The dipole moment for the l-isohydrobenzoin ($2{\cdot}70 \times 10^{-18}$ e.s.u.) is found to be identical with the moment of the racemic form ($2{\cdot}72 \times 10^{-18}$ e.s.u.), whereas the meso-compound hydrobenzoin is characterised by the moment, $2{\cdot}48 \times 10^{-18}$ e.s.u. H. H. Ho.

**2781. Electric Moments of Halogen Derivates of Saturated Hydrocarbons. P. Barchewitz.** *Comptes Rendus,* 204. *pp.* 677–679, *March* 1, 1937.—There is a correlation between the frequency corresponding to the C-H type of vibration and the electric moment of the molecule, or more exactly the electric moments of the different parts of the molecule and their orientation with respect to the vibrating bond. R. P.

**2782. Anomalous Dispersion in Polar Liquids. P. Abadie.** *Onde Élec.* 16. *pp.* 89–113, *Feb., and pp.* 247–268, *April,* 1937.—The measurements are made by means of Drude's second method, and experimental precautions necessary for the highest accuracy are described. Equations of the resonance curves are derived for the case of a polar liquid of complex dielectric constant, and from the curves the dielectric constant and coefficient of absorption of the liquids can be calculated. Results obtained by this method on normal propyl alcohol at wave-lengths from 17 cm. to 6 m. show good agreement with Debye's dipole theory. E. R.

**2783. Dipole Moment of Chlorobenzene. F. H. Müller.** *Phys. Zeits.* 38. *pp.* 283–292, *April* 15, 1937.—The effect of the solvent on the apparent dipole moment of chlorobenzene is determined by measurements on the chlorobenzene in 34 different solvents. In general, the dipole moment is less, the greater the dielectric constant of the solvent. The results are discussed in the light of Frank's theory [see Abstract 4673 (1935)] and Debye's theory of a quasi-crystalline structure of liquids [see Abstract 1813 (1935)]. E. R.

**2784. Dielectric Constant and Field Strength. C. J. Bouwkamp and B. R. A. Nijboer.** *Physica,* 4. *pp.* 370–388, *May,* 1937. *In German.*—A mainly mathematical paper, in which it is shown that the existing formulæ by means of which the dipole moments of polar liquids are derived from the measured variation of dielectric constant with field strength, are incorrect. Corrected formulæ are given which enable only an upper limit for the dipole moment to be calculated from the experimental data. E. R.

**2785. Theory of Electrical Breakdown in Ionic Crystals. H. Fröhlich.** *Roy. Soc., Proc.* 160*A. pp.* 230–241, *May* 18, 1937.—The time of relaxation of an electron in an ionic lattice has been calculated. Hence the critical field F for electrical breakdown has been calculated quantitatively. Satisfactory agreement with the experiments of v. Hippel is obtained [see Abstract 4674 (1935)]. F increases: (1) with increasing temperature (for high temperature F ∝ √T, if $T < T_0$, $T_0$ is the temperature where heat breakdown begins); (2) if foreign ions are introduced into the lattice (experiments by v. Hippel); (3) for layers of about $10^{-4}$ cm. thickness. AUTHOR.

**2786. Use of Relaxation Oscillations for the Measurement of Capacities. R. Guillien.** *Comptes Rendus*, 204. *pp.* 668–670, *March* 1, 1937.—An arrangement is described in which use is made of the oscillations of an intermittent character which can arise when a condenser shunted by a resistance is in series with an oscillating circuit between the grid and the filament of an oscillating valve. The arrangement permits of measurements both accurate and rapid, and is especially suitable for the study of the dielectric constant of liquefied gases where the time is limited. J. J. S.

***2787. Recording Minute Changes of Capacitance. W. D. Oliphant.** *Journ. Sci. Instruments*, 14. *pp.* 173–177, *May*, 1937.—The paper describes a method for highly magnifying and for recording oscillographically h.f. minute transient changes of capacitance, and consists in using the capacitance change to tune a simple oscillatory circuit through its resonant point. This circuit is loosely coupled to another oscillatory circuit tuned advantageously to some point on the side of its resonance curve and the effect of the former circuit is to alter the effective impedance of the latter according to a definite law, and this is indicated by means of a valve voltmeter, which indication may, for example be recorded on an electromagnetic or kathode-ray oscillograph, a d.c. valve amplifier being incorporated to obtain the necessary current. The circuits are excited by a valve oscillator which is loosely coupled to the valve voltmeter oscillatory circuit. While the method has only been used for recording transient fluid pressures, it has nevertheless a wide field of useful applications where measurement or observation of small changes of capacitance is important. The method facilitates the recording of any physical, or mechanical phenomenon which can conveniently be adapted to produce a small change of capacitance of the order of a few $\mu\mu$F. AUTHORS.

*See also* Abstracts 2403, 2445.

## ELECTROCHEMISTRY.

**2788. Cells with One Polished Electrode: Effect of Beilby Layer. A. Grumbach and F. Taboury.** *Comptes Rendus*, 204. *pp.* 1178–1179, *April* 19, 1937.—Pt wire embedded in glass, cut off level with the surface thereof and polished, though showing no e.m.f. against another Pt electrode whether polished or not, in acidified $H_2O$, behaves as a condenser shunted with a high resistance. This behaviour is clearly connected with the non-crystalline nature of the Beilby layer produced by polishing. Au behaves similarly. C. A. S.

**2789. Overvoltage: Effect of Fusion of the Kathode and Effect of Temperature on Gas Polarisation. A. Butts and W. A. Johnson.** *Am. Electrochem. Soc., Trans.* 70. *pp.* 259–274; *Disc.*, 274–279, 1936.—

The cause of overvoltage is doubtful. Measurements were made of cell voltages and gas polarisation voltages in cells with a Wood's alloy kathode and with a gas kathode while the temperature of the cell varied so as to cause the kathode to melt and to freeze. No change of polarisation was found, except with Wood's alloy when it had not reached equilibrium. Hence, neither the internal physical structure nor the total energy content of metals are factors in overvoltage. Sharp rises of voltage were observed with a liquid Ga kathode and also sudden pronounced flattening of the liquid Ga. The high polarisation voltages of $H_2$ on the low melting metals are not due to low energy content. Gas polarisation on a liquid alloy kathode is affected by change of equilibrium in the alloy, or by melting. Gas polarisation voltages generally fall with rise of temperature. The overvoltage of $H_2$ on Wood's alloy is 0·63 ± 0·05 V at 70°–85° C. and on Ga 0·60 ± 0·05 V at 25°–30° C. These figures are the same for the solid and liquid states. J. J. S.

**2790. Overvoltage of Iodine in Fused Electrolytes. S. Karpatschoff and O. Poltoratskaja.** *Acta Physicochimica*, 6. 2. *pp.* 275–278, 1937. *In German.*—The overvoltage of iodine was investigated as a function of the current strength, and the AgI and LiI content of the fused electrolytes. The electrolytes employed were fused AgCl and AgI, and LiI and LiCl. It was shown that in the cases of these electrolytes, the overvoltage was independent of the composition of the electrolyte, within the limits of accuracy of the method. F. J. B.

**2791. Electrolysis of Iodine Monochloride in Various Solvents. C. Sandonnini and N. Borghello.** *Accad. Lincei, Atti*, 25. *pp.* 46–52, *Jan.* 3, 1937.—The polar moment of ICl in solutions of $CCl_4$ and of $C_6H_5(NO_2)$ is somewhat higher than in the gaseous state. Electrochemical researches have led to discordant results and the interpretation is not always certain. The work of various investigators is here referred to and the authors have limited their experiments to the electrolysis of ICl and of pure I in acetic acid and nitrobenzene. The results in acetic acid may be explained by assuming that in the solutions the ICl exists in the form of an autocomplex $I(ICl_2)$, even if in quantity not very great its molecular weight is almost normal, and attributing to the ion $(ICl_2)$ a migration value very high and to the ion $I^+$ a value almost zero. For solutions in nitrobenzene the same explanation does not hold. Many investigators consider that the predominant factor for every type of solution examined is the formation of complex oxides. The general results show that a substance can undergo very profound modifications of its constitution which are due essentially to the nature of the medium by which it is surrounded. J. J. S.

**2792. Electrolytic Depolarisation with H.F. Current. I. Ranzi and R. Ricamo.** *N. Cimento*, 14. *pp.* 1–7, *Jan.*, 1937.—On measuring the temperature of the electrode depolarised by h.f. current it was found that the cause of the depolarisation was purely thermal. On heating the electrode the depolarisation is the same even if recourse is had to other means of heating instead of using h.f. current. J. J. S.

**2793. Structure of Electrolytic Deposits. P. Jacquet.** *Comptes Rendus*, 204. *pp.* 670–672, *March* 1, 1937.—Electrolytic deposits present two types of structure. Deposits of Cu, Ag, Pb, Zn, obtained from solutions of simple salts are formed of very distinct crystals, whilst these same metals give by electrolysis of their complex salts deposits formed of microcrystals which are practically invisible. Metals of the Fe group present generally this second structure on electrolysis of their simple salts. The presence of hydrophilous colloids tends to the formation of a microcrystalline structure. No adequate explanation has been given of these differences of structure. Colloids—either found near the kathode or consisting of organic colloids added—interfere with the normal increase of crystals. H-ions can play the same rôle. The results obtained show: (1) It is possible in general to find experimental conditions which correspond to a regular growth of the crystalline network of the kathode; (2) the deposit of Ni is always formed of microcrystals; (3) if the electrolytic deposit is accompanied by the discharge of H-ions, the crystalline network of the kathode has no longer any influence on the initial distribution of the metal. The results confirm and extend Thon's hypothesis relative to the inhibition of the active centres of a polycrystalline metallic kathode. They show that the discharge of H-ions plays an essential part in the structure of the metals mentioned. [See also Abstract 1349 (1937)]. J. J. S.

***2794. Electrolysers with Mercury Kathode. O. Dony-Hénault and A. de Jaer.** *Comptes Rendus*, 204. *pp.* 1176–1178, *April* 19, 1937.—An arrangement is described with anode of Ta-Pt (requiring but little Pt) and kathode of unoxidisable steel dipping in Hg maintained at 100° and suitably agitated, which gives a high yield of K or Na amalgam. Thus with currents of 88 and 90 A and current density 4890 and 5000 $A/m^2$, yields of 95 and 99·5 % were obtained in the electrolysis of KCl and NaCl solutions respectively. C. A. S.

**2795. pH Values of Reference Solutions. Y. Kauko and A. Airola.** *Zeits. f. phys. Chem.* 178. *Abt.A.* 6. *pp.* 437–454, 1937.—The potentiometric determination of the degree of acidity is unreliable because the pH value of the reference solution is not accurately known. By the employment of a $10^{-4}$ *M* $NaHCO_3$ solution completely saturated with pure $CO_2$, as a reference solution, the authors are able to determine the degree of acidity by the estimation of the $CO_2$. The e.m.f. of a cell with a very slight diffusion potential, and the application of the Debye-Hückel theory together with the $CO_2$ determination enabled the pH value of the solution to be obtained. The method led to results which were reproducible to within 0·002 pH. F. J. B.

**2796. Extension of Debye-Hückel's Theory of Strong Electrolytes. S. Kaneko.** *Electrot. Laborat. Tokyo, Japan, Researches, No.* 403. [15 *pp.*], 1937. *In English.*—The author has extended the Debye-Hückel theory of strong electrolytes and, utilising an integral equation as Gronwall did, has obtained more accurate formulæ for activity, osmotic coefficient and heat of dilution. The integral equation treated here differs substantially however from Gronwall's which is very complicated. The author's equation can easily be derived from Debye-Hückel's differential equation and its solution is not so difficult as Gronwall's. Taking into consideration the size of ions, conductivity and diffusion coefficients are also calculated as an extension of Onsager's theory. AUTHOR.

**2797. Dissociation of HF. W. A. Roth, H. Pahlke, A. Bertram and Erika Börger.** *Zeits. f. Elektrochem.* 43. *pp.* 350–355, *May*, 1937.—Heats of dilution between *N*/1·8 and *N*/1400, measured at 20° C., consistently exceed the positive heats of dissociation, in contrast to previous data. Between *N*/50 and *N*/700 a dissociation of $2{\cdot}2 \times 10^{-4}$ may be calculated, but this really is a pseudo-constant since the value rises on further dilution. pH can be determined in polished Pt basins in reflected daylight with methyl violet as indicator, glass vessels being unsuitable owing to attack by HF. On dilution the limiting value of $5 \cdot 5 \times 10^{-4}$ for $[\mathrm{H}^{\cdot}]\,[\mathrm{F}']/[\mathrm{HF}]$ is attained. Up to *N*/8, directly determined pH values agree well with those deduced from transport number measurements, so that Davies and Hudleston's assumption $\mathrm{HF} + \mathrm{F}' \rightleftharpoons \mathrm{HF}_2'$ is confirmed. D. R. H.

**2798. P.D. at Metal-Vapour, Vapour-Liquid and Liquid-Metal Interfaces of Partially Immersed Electrodes. C. G. Fink and R. C. Dehmel.** *Am. Electrochem. Soc., Trans.* 70. *pp.* 281–320; *Disc.*, 320–322, 1936.—By means of apparatus described the p.d. across the vapour between the exposed portion of a partially immersed electrode and the surface of the solution into which it dips was shown to exist and its magnitude measured. A shielded oscillating electrode was employed for the measurement of the rapidly changing contact p.d. With this arrangement an a.c. amplifier and an audible detector may be used and thus high sensitivity with electrical stability are obtained. Quantitative measurements were made of the p.d. across the vapour with the metals Cu, Au and Pt, each dipping into aqueous molar solutions of their salts. The change occurring in the voltage drop across the vapour when $O_2$ is admitted was observed, and also the effects of dissolved $O_2$ on the solution voltages of Cu, Au and Pt. The effect of the p.d. existing across the vapour of a partially immersed electrode on the corrosion of the electrode is discussed. Tables are given of p.d.s existing across the vapour of the three metals dealt with when partially immersed in aqueous solutions of their salts, first, when only the vapour of the electrolyte is present, and second, when $O_2$ is present in the cells at a pressure of 1 atmos. The presence of $O_2$ causes the solution voltages to become less anodic. The changes in solution voltage with the introduction of $O_2$ are small in the case of Cu and Au as compared with the changes in the p.d. existing across the vapour, the ratio being of the order 1·100. In the case of Pt this ratio is more nearly unity. There is not sufficient natural ionisation of the atmosphere for the vapour field voltage of a partially immersed electrode to become important as a corroding factor. Equilibrium voltages are rapidly obtained in cells having Cu or Au electrodes, but slowly in cells with bright Pt electrodes. J. J. S.

**2799. Mercurous Acetate Electrode. W. D. Larson and F. H. MacDougall.** *J. Phys. Chem.* 41. *pp.* 493–498, *March*, 1937.—The e.m.f.'s of the cell Pt | HOAc (satd. with quinhydrone), HOAc (satd. with $Hg_2(OAc)_2$, $Hg_2(OAc)_2$ (solid) | Hg are measured at 25° C., at concentrations of acetic acid varying from 0·05 to 2·0 *M*. From these data the standard e.m.f. of the electrode Hg | $Hg_2(OAc)_2$, $OAc^-$ is found to be $-0 \cdot 5109 \pm 0 \cdot 0002$ volt at 25° C. AUTHORS.

*See also* Abstracts 2324, 2347, 2360, 2434, 2437, 2520, 2721, 2728.

## ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

**2800. Fermi Theory of Positron Emission. C. Möller.** *Phys. Zeits. d. Sowjetunion,* 11. 1. *pp.* 9–17, 1937. *In German.*—Using Fermi's theory, the change of a proton into a neutron with the absorption of a neutrino and an electron is examined. The electron can come either from a negative state, *i.e.*, positron emission, or from the K shell. It is shown that, especially in the case of heavy nuclei, the latter process is the more probable. The probability of $\gamma$-radiation accompanying the change is also calculated. J. E. R. C.

**2801. Secondary Electron Emission and Photo-Sensitivity. A. Dobroljubski.** *Phys. Zeits. d. Sowjetunion,* 11. 1. *pp.* 118–121, 1937. *In German.*—The results of an earlier paper of the author [see Abstract 888 (1937)] are commented upon. R. P.

**2802. Secondary Electron Emission from Solids. R. Kollath.** *Phys. Zeits.* 38. *pp.* 202–224, *April* 1, 1937.—A detailed summary, with Bibliography, is given of work on secondary emission under the headings: (I) Measurement and general form of energy distribution of the secondary emission. (II) Angular distribution. (III) Production of secondary electrons, expressed as a function of the primary electron energy; effect of gas, structure and temperature of the material emitting, angle of incidence of the primary electrons; results of measurements on pure metals, metallic films and compound surfaces. (IV) Secondary emission from insulators. (V) High primary energies. (VI) Theoretical treatment. (VII) Technical applications, amplifiers, secondary electron multipliers, etc. H. J. H. S.

**2803. Electron Gas in a Magnetic Field. E. Lifschitz.** *Phys. Zeits. d. Sowjetunion,* 11. 2. *pp.* 141–156, 1937.—*In German.*—A kinetic equation is derived for a gas consisting of charged particles in a magnetic field; from this equation the relaxation time (*i.e.*, the time to attain the Maxwellian distribution) and the thermal conductivity coefficient are deduced. The divergence of a bundle of charged particles travelling in the direction of the field as a function of the time is considered and formulæ are given from which the breadth of a beam at any distance from the source may be calculated. [See also Abstract 490 (1937).] H. J. H. S.

**2804. Drift of Ions and Electrons in a Magnetic Field. L. Tonks.** *Phys. Rev.* 51. *pp.* 744–747, *May* 1, 1937.—Townsend's equations for the drift motion of ions under the combined action of magnetic field, concentration gradient and electric field are shown to be inconsistent with the Boltzmann equation. Other relations according to which a gradient contributes a perpendicular component to the drift are shown to be satisfactory in this respect. It is proved that such contributions exist and the fallacy in the demonstration that they do not exist is exposed. These equations lead to the simple result that the drift speed is the same as would occur if the components of concentration gradient and electric field perpendicular to it, as well as the magnetic field itself, did not exist. All of the equations are only semiquantitatively correct and are subject to refinement by a more adequate statistical treatment. AUTHOR.

**2805. Deflection of a Current in a Gas by a Magnetic Force. J. S. Townsend.** *Phil. Mag.* 23. *pp.* 880–885, *May,* 1937.—It has been shown that the equations for the mean velocities of charged particles in a uniform electric field depend on a simplification which introduces inaccuracies when these equations are applied to electrons. The deflection $\theta$ due to a small magnetic field is calculated, taking into consideration the conditions with regard to free paths of small particles in a gas and the effect of collisions on the direction of motion of the particles. The numerical constant in the equation derived depends on the distribution of the velocities of agitation of the electrons, which is generally less wide than the Maxwellian distribution. C. J. B. C.

**2806. Ionic Impacts with Strong Resonance. F. Wolf.** *Ann. d. Physik,* 29. 1. *pp.* 33–47, *May,* 1937.—The author has measured by established methods the dependence of the active cross-section of an ionised, potential-varying ion on the ray velocity during impacts, where slowly moving ions collide with their own gas molecules. Results are given for He, Ne, A, $H_2$ and $N_2$ as follows: (1) The varying cross-sections found are large throughout, and all the curves fall slowly in the direction of the large ray velocities in accordance with the theoretical predictions. (2) For small ray velocities the curves show a maximum with succeeding decline; thereby confirming previous isolated observations. (3) Ionisation by impact of individual ions has only been established for the three inert gases. (4) The active cross-section curves, apart from a small irregularity of hydrogen which is possibly due to dissociation processes, indicate a uniform descending course with increasing radiation energy. This behaviour is in agreement with theory, since the total effect depends primarily on the charge variation. The results are compared with previous data. H. H. Ho.

**2807. Collision of Neutron and Proton. Part II. P. M. Morse, J. B. Fisk and L. I. Schiff.** *Phys. Rev.* 51. *pp.* 706–710, *May* 1, 1937.—A neutron-proton potential field of the form discussed in an earlier paper [see Abstract 5280 (1936)] has been chosen, of radius $r_0 = 2 \cdot 7 \times 10^{-13}$ cm, with a triplet depth of 36·04 eMV, corresponding to a binding energy of 2·2 eMV for the deuteron. Two different singlet depths are used, 14·64 eMV and 16·36 eMV, corresponding to cross-sections for neutron-proton scattering of 12 and $40 \times 10^{-24}$ cm$^2$., respectively, having no stable singlet state. Using these potentials, the elastic and inelastic collison of neutron and proton have been computed for a range of enegies of the incoming neutron from 0 to 40 eMV. The angular distribution of elastic scattering shows decided departure from the spherical symmetry predicted by the use of a "square hole" potential; and is in fair agreement with available experimental data. Agreement is also obtained with experimental data on elastic cross-section and capture cross-section for fast neutrons. Curves for cross-section for deuteron disintegration by $\gamma$-rays are also computed. Experimental confirmation of these will provide a test of the correctness of our choice of form of potential. In all these cases, the results for the two different singlet potentials are practically identical for energies larger than 1 eMV. AUTHORS.

**2808. Inelastic Collision of Deuteron and Deuteron. L. I. Schiff.** *Phys. Rev.* 51. *pp.* 783–788, *May* 15, 1937.—Certain symmetry properties of the two deuteron-deuteron reactions are developed in a rigorous manner, and are shown to require a distribution of the reaction products for moderate incident deuteron energies of the form $A(1 + B\cos^2\theta)$ in the coordinate system in which the centre of mass is at rest. This is shown to be in qualitative agreement with recent experimental data. The quantities A and B are evaluated approximately using a modification of Born's method and neglecting polarisation of the deuterons; the quantitative discrepancies between theory and experiment are discussed. The theoretical relative yield from a "thick" deuterium target agrees well with the results of several experimenters; this quantity is influenced mainly by the Gamow factor, and is relatively independent of the details of the theory. The theoretical absolute yield is too large to agree with experiment. AUTHOR.

**2809. Diffraction of Electrons of Average Energy. S. Loria and J. Klinger.** *Acad. Polonaise Sci. et Lettres, Bull.* 1–2*A. pp.* 15–22, *Jan.–Feb.*, 1937. *In German.*—The diffraction of electrons of energy from 18,000 ekV down to 4500 ekV, on passage through a polycrystalline sheet of uniform thickness is examined photographically. A spun metal base is used to support the powdered crystalline sheet. Exact measurements are made on ZnO. Above 8000 ekV the results agree with previous workers; in the extension down to 4500 ekV the de Broglie relation is found to hold to an accuracy of 0·4%. F. C. C.

***2810. Electron Diffraction Camera with Movable Observation Microscope. F. Schoszberger and K. Schwarz.** *Zeits. f. Elektrochem.* 43. *pp.* 324–326, *May*, 1937.—Previous methods employed in the use of electron-beams are discussed, following which comes the detailed description of a modified type of electron diffraction camera which obviates the earlier difficulties encountered. H. H. Ho.

**2811. Damped Electron Waves in Crystals. J. C. Slater.** *Phys. Rev.* 51. *pp.* 840–846, *May* 15, 1937.—Electrons in solids, as in electron diffraction, suffer inelastic impacts if their energy is great enough to exceed the resonance energy of the atoms of the crystal, resulting in strong damping of the electron beams, with consequent broadening of the reflected peaks about the Bragg scattering angles, and reduction of the reflection coefficient. The problem is discussed mathematically, on the basis of the conventional theory of electron diffraction, by introducing an empirical damping constant in the form of a pure imaginary term in the potential. It is shown that such a constant leads to damped waves of the required sort, and the equations for energy and reflection coefficient are set up. The results are qualitatively of the sort necessary to explain the observations, though no marked asymmetry in the reflected peaks is predicted. Presumably the observed asymmetries arise, as Harding has suggested, from irregular spacings of the atomic planes near the surface. One interesting result of the theory is that the sharp distinction between allowed energy bands and forbidden gaps, which is found in the theory of undamped electrons in periodic lattices, is lost, for all waves are more or less damped. [See following Abstract.] AUTHOR.

**2812. Wave Functions in a Periodic Potential. J. C. Slater.** *Phys. Rev.* 51. *pp.* 846–851, *May* 15, 1937.—A new method for approximating the solutions of the problem of the motion of an electron in a periodic potential, as a crystal lattice, is suggested. The potential is supposed to be spherically symmetrical within spheres surrounding the atoms, constant outside. The wave function is expanded in spherical harmonics and radial solutions of the wave equation within the spheres, and in plane waves outside the spheres, joining continuously at the surface. A single unperturbed function consists of a single plane wave outside the spheres, together with the necessary spherical functions within the spheres. The matrix components of energy are set up between these unperturbed functions, and the secular equation set up. This equation involves the energy explicitly, and also implicitly through the ratio of the slope of the various radial functions to the functions themselves at the surfaces of the spheres, and must be solved numerically. It is hoped that the method will be useful for comparatively low energy excited electrons, for which the usual method of expansion in plane waves converges too slowly. [See preceding Abstract.] AUTHOR.

***2813. Cold-Kathode Oscillographs. G. Induni.** *A.T.M. No.* 70. *T*51–*T*53, *April*, 1937.—A description is given, with photographs, of the high vacuum kathode-ray oscillographs due to Matthias, v. Borries, Rogowski and Westerman and to the firms Cambridge Instrument Co., Trüb-Täuber and Co. and Westinghouse. Mention is also made of types constructed by the Metropolitan Vickers Co. and by a number of individual workers. **H. J. H. S.**

*See also* Abstracts **2292, 2308, 2309, 2312, 2333, 2343, 2348, 2414, 2548, 2767, 2768, 2793, 2843, 2855, 2862, 2863, 2864.**

### GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

***2814. Magneto-Resistance Effect in Cadmium at Low Temperatures. C. J. Milner.** *Roy. Soc., Proc.* 160*A. pp.* 207–229, *May* 18, 1937.—Apparatus is described which was used to measure the increase of electrical resistance of specimens of Cd at low temperatures, in magnetic fields up to 26 kilogauss. At temperatures above 20° K., Kapitza's observation, that for strong fields a linear variation of resistance with field strength replaced the initial square law, was confirmed. Experiments at 20·4° K. with polycrystalline wires of differing purity showed that the coefficient $b$ of the linear law was the same for all specimens, and that the critical field from which the linear increase started was proportional to the specific resistance of the specimen. Experiments at 77° K. supported these findings. A disagreement with Kapitza's conclusions is discussed. At He temperatures a new effect was found. In addition to the linear effect mentioned, a square-law increase was observed, producing a very large increase of resistance in pure specimens. The increase of resistance could be represented as $a \times H^2 + b \times H$, where $b$ was again constant, and $a$ was inversely proportional to the residual resistance of the specimen. Experiments were made in which the temperature varied between 3° and 21° K. These showed that the coefficient $a$ is constant at the lowest temperatures, but falls rapidly above 4° K. to negligible values, $b$, however, varies only slightly with the temperature. The $a$ effect is absent when the magnetic field is parallel to the current, and the curve then shows a saturation effect, at He temperatures. The evidence available from other workers is discussed. It would seem that the $a$ effect has previously been observed, though not recognised, in other metals of the non-cubic groups; but that the effect is absent, or much smaller, in the cubic metals, Cu, Ag, Au, and Al. AUTHOR.

*See also* Abstract **2866.**

### MAGNETISM AND ELECTROMAGNETISM.

**2815. Magnetic Energy and the Thermodynamics of Magnetisation. E. C. Stoner.** *Phil. Mag.* 23. *pp.* 833–857, *May*, 1937.—Owing to apparent inconsistencies in the treatment of magnetic energy in some recent papers, it is thought desirable to treat the matter directly by considering the mechanical work done in moving elementary particles, agglomerates of such particles and inductively magnetisable bodies in an external field. There are two cases to be considered: the field produced ($a$) by a system of fixed rigid permanent magnets, and ($b$) by any system whatsoever. For rigid bodies it is found that, for a single inductively magnetisable body, the magnetic contribution to the total energy of the body in an external field $H_e$ is $-\int_0^{H_e} I.dH_e$ per unit volume; this may be regarded as made up of contributions to the energies of the external and demagnetising fields and the internal energy. Two sets of thermodynamic functions based on the total energy function and the internal energy are given and discussed. When the "rigidity" restriction is removed, account is taken of work done against or by externally applied

forces and of magneto-deformation effects. The "fundamentality" of B and H is discussed and it is suggested that specifications of magnetic characteristics may be made in terms of any pair of the quantities I, B and H, whichever is the more convenient. [See also Abstract 1858 (1935).]
H. J. H. S.

**2816. Measurement of Magnetic Properties at Very High Frequencies. G. Potapenko and R. Sänger.** *Zeits. f. Physik*, 104. 11–12. *pp.* 779–803, 1937.—Describes a method of measuring the permeability of ferromagnetic metals, specially suitable at frequencies of $10^8$ to $10^{10}\sim$, and requiring only a very small specimen. A Lecher system is used consisting of two parallel Cu wires with two connecting bridges, one a massive plate giving complete reflection, the other a wire of the test-material. By means of resonance curves, measurements are made of the damping of the system, and of the "bridge-contraction" (the amount by which the distance between the bridges at the first resonance peak is less than the half-wave-length). Expressions are developed for deriving from these two quantities respectively the resistance and inductance of the wire-bridge, from either of which the permeability may be deduced. The factors affecting the accuracy of the results are discussed and it is shown that the sources of error may be greatly reduced by making comparison measurements with a wire-bridge of a non-magnetic metal, *e.g.*, Cu. An example of the experimental results is given, showing good agreement with theory; full results obtained by the method are to be published later.
C. E. W.

**2817. Discontinuities of Magnetisation in Alternating Field. S. Procopiu and G. Vasiliu.** *Comptes Rendus*, 204. *pp.* 971–973, *March* 22, 1937.—A previous paper [see Abstract 2257 (1937)] describes a circular Barkhausen effect in which currents are induced in a small coil when the a.c. in a ferromagnetic wire creates a field greater than Hc. A small amount of torsion produces the effect more easily, and the strength of a.c. required for a given inductive effect varies in the inverse direction with the angle of torsion. Several modifications of the original experiment are described, and an explanation of the effect is given.
G. E. A.

**2818. Ferromagnetic Curie Points and the Absolute Saturation of Some Nickel Alloys. V. Marian.** *Ann. de Physique*, 7. *pp.* 459–527, *April*, 1937.—A new apparatus is used to measure Curie points down to low temperatures. The variations with composition of the Curie points and of the mean atomic moments of several Ni alloys are measured. It is found, in agreement with existing data, that, in general, these variations are linear and that there is a marked parallelism between them, both reaching zero values in an alloy of the same composition on extrapolation. This alloy usually corresponds with an intermetallic compound of definite composition. For most alloys the slope of the mean atomic moment curve is proportional to the atomic number of the added metal.
W. R. A.

**2819. Magnetic Powder Experiments on Rolled Ni-Fe. Part II. J. L. Snoek and M. W. Louwerse.** *Physica*, 4. *pp.* 257–266, *April*, 1937. *In English.*—Preliminary results of an investigation on the structural properties of specially treated Ni-Fe strips using the sedimentation method due to Bitter [see Abstract 1865 (1936)] are extended for anisotropic specimens. An account is given of observations made on polished surfaces in the *xz* and *yz* planes, as well as the results of a more detailed examination of the effects produced in the rolling plane (*xy*). In the *xz* plane no lines are observed but in the *yz* plane in weak fields (I = 50) a zigzag pattern is obtained which disappears in higher fields; on reversal of the field a complementary pattern is obtained. In the rolling plane the lines are straight and parallel but on reversal of the field new lines are observed which lie alongside the former; after demagnetisation the original line system is replaced by one of irregular character. Reversal of the field then produces a line system which intersects the first system. An attempt is made to account for this phenomenon but further experiment is necessary to elucidate it fully. H. J. H. S.

**2820. Powder Patterns on Ferromagnetic Crystals. K. J. Sixtus.** *Phys. Rev.* 51. *pp.* 870–877, *May* 15, 1937.—The regular patterns which, as Bitter has found, form on ferromagnetic single crystals from a suspension of magnetic iron oxide have been studied on large crystals of 3·5 % silicon-iron. Three different types of patterns were observed at low, medium, and high fields, respectively. The direction of Type I and Type II patterns is determined by the crystal orientation; that of Type III is always nearly normal to the applied field. Type I patterns were found only after polishing or otherwise straining an annealed sample, and the line spacing stayed constant (except at H = 0) as the field was increased. We conclude that surface strains are essential in producing this type of pattern. Type II patterns were little affected by stress, and the lines multiplied when the longitudinal or normal field component was increased. Certain dissymmetries of the lines and their behaviour near a hole in the sample were studied. It is concluded that the Type II lines are formed at the intersections of magnetic "sheets," lying in dodecahedral (110) planes, with the surface. Type II patterns form near surface inhomogeneities where the magnetic flux is forced to cross the surface and where the magnetisation accordingly has a normal component. AUTHOR.

**2821. Anomalous Diamagnetism of Selenium. M. Prasad and S. S. Dharmatti.** *Indian Journ. Phys.* 11. *pp.* 1–8, *Feb.*, 1937.—The authors have studied the effect of powdering and colloidalisation on the magnetic property of Se. The period of powdering had the effect that after 33 hrs., $\chi \times 10^6$ was reduced from $-0{\cdot}2887$ to $-0{\cdot}1108$, and after 40 hrs., the powder had become paramagnetic with $\chi \times 10^6$ equal to $+0{\cdot}007$. This increased to $+0{\cdot}0862$ after 46 hrs. powdering. During powdering the dark grey colour of the metal crystals changed first to pink and then to red. A diminution in the diamagnetic susceptibility was also noted when the Se was powdered under paraffin oil. When the Se sol was prepared and dried in air it was paramagnetic, when dried in a vacuum it was diamagnetic. The effect of treating Se powders with HCl was to make them more diamagnetic. The results are explained on the consideration that during powdering and colloidalisation, Se is converted into an allotropic modification. G. E. A.

**2822. Magnetic Properties and Structure of Ferrihemoglobin and Compounds. C. D. Coryell, F. Stitt and L. Pauling.** *Am. Chem. Soc., J.* 59. *pp.* 633–642, *April*, 1937.—Magnetic measurements at approximately 24° of solutions of ferrihemoglobin and some of its compounds are made, leading to values of the paramagnetic part of the molal susceptibility which correspond to the following values of the effective magnetic moment per heme, in Bohr magnetons: ferrihemoglobin, 5·80; ferrihemoglobin hydroxide, 4·47; ferrihemoglobin fluoride, 5·92; ferrihemoglobin cyanide, 2·50; ferrihemoglobin hydrosulphide, 2·26. For ferrihemoglobin and its fluoride these correspond to five unpaired electrons per heme, indicating essentially ionic bonds; for the cyanide and hydrosulphide to one, indicating essentially covalent bonds; and for the hydroxide to three, indicating bonds of an intermediate type. Values determined by magnetic titrations are reported for the dissociation constants of ferrihemoglobin hydroxide, fluoride and cyanide. AUTHORS.

**2823. Magnetic Susceptibility of the Vapours of Organic Compounds. J. Shur.** *Phys. Zeits. d. Sowjetunion,* 11. 2. *pp.* 194–203, 1937. *In English.*—Previous investigations on the magnetic susceptibility of the vapours of organic compounds are critically reviewed. It is shown that the anomalous susceptibility found by Vaidyanathan [see Abstract 456 (1928)] for the vapours of $CS_2$ and benzene cannot be reasonably explained. The magnetic susceptibilities of gaseous $CS_2$ and benzene are measured and it is shown that they do not differ, within the limits of experimental accuracy, from the susceptibilities in the liquid state. AUTHOR.

**2824. Magnetic Properties of Manganese Amalgams. L. F. Bates and L. C. Tai.** *Phys. Soc., Proc.* 49. *pp.* 230–236, *May* 1, 1937.—The variation with temperature of the magnetic susceptibilties of a series of Mn amalgams of known concentration have been determined over a range from 15° to 350° C. The amalgams show pronounced temperature hysteresis of their magnetic properties, and show that the Mn becomes more paramagnetic as the temperature rises, until, in the case of the more concentrated amalgams, a steady state is reached. The phenomena are briefly discussed in the light of the recent theories of alloys. AUTHORS.

**2825. Paramagnetism. Part IV. Ultra-Violet Absorption Spectra of Paramagnetic Halides in Solution. S. Datta and M. M. Deb.** *Phil. Mag.,* 23. *pp.* 1005–1017, *May,* 1937.—The u.v. absorption spectra due to halogen ions or atoms in solutions of $CrCl_3$, $CoCl_2$ and $NiCl_2$ in different media are investigated. In aqueous solution the edge of continuous absorption is shifted slightly towards longer wave-lengths whereas with the same salt concentration in HCl or in ethyl alcohol a pronounced shift towards longer wave-length of several thousand wave-numbers is encountered. It is concluded that in aqueons solution the halide is very largely dissociated but in the other two solutions undissociated halide molecules are formed. [For Part III see Abstract 332 (1936)]. W. R. A.

**2826. Mutual Inductance of a Circle and an Arbitary Circuit. R. Sartori.** *Elettrotecnica,* 24. *pp.* 135–138, *March* 10, 1937.—The Neumann double integral reduces in this case to a simple integral whose integrand contains a linear function 2(K-E)/k-kK of the complete elliptic integrals E and K. This function is tabulated with $k^2$ as argument. The simple integral is transformed into a finite series by replacing the arbitary circuit by an inscribed polygon. The method is applied to the calculation of a variable mutual inductor consisting of two concentric circles. P. V.

**2827. Effect of Mechanical Stress on Ferromagnetic Properties of Cubic Single Crystals. H. Schlechtweg.** *Ann. d. Physik,* 28. 8. *pp.* 701–720, *April,* 1937.—The problem of a disc of a ferromagnetic body under any conditions of stress suspended in a uniform magnetic field is considered theoretically. On the assumption that an elastic potential exists, the torsional moment for the limiting case of an infinitely great field strength is calculated (for anisotropic magnetostriction arising by rotation of the magnetisation vector). The torsional moment is also derived for a field which is parallel to a cubic edge of the crystal lattice and certain laws are deduced for simple regular orientations of the plane of the disc. The stress resultants are then considered for the general case, from which it follows that the torsional moment arising by pure rotation of the magnetisation vector is independent of any hydrostatic pressure or tension. Curves for the torsional moment show, in general, periods including $\pi/2$ if there is no stress but including $\pi$ if stress is present. The stress resultants are calculated for a simple case. H. J. H. S.

**2828. Magnetostriction of Iron Crystals at High Temperatures. H. Takaki.** *Zeits. f. Physik,* 105. 1–2. *pp.* 92–103, 1937.—A simple mechanical-optical system is used to measure the magnetostriction of Fe crystals at temperatures up to 750° C. The constant C which expresses the longitudinal elongation in the tetragonal axis (for saturation conditions) increases with increasing temperature, reaches a maximum value of 500° C. and then decreases rapidly to zero at the Curie point. The constant $\chi$ for the trigonal axis decreases with rising temperature and disappears at about 500° C. The curves do not agree with those expected theoretically, but it is shown that the curve for the decrease in $\chi$ proceeds in an identical manner with the anisotropy constant K; the constants $\chi$ and K may thus be linked theoretically. H. J. H. S.

*See also* Abstracts 2340, 2400, 2696, 2707, 2708, 2744.

## MEDICAL RADIOLOGY AND ELECTROLOGY.

***2829. Tomography. E. W. Twining.** *Brit. J. of Radiology,* 10. *pp.* 332–347, *April,* 1937.—The article describes the construction of a new apparatus designed to enable tomography to be performed with radiographic couches having a suitably mounted travelling tube column and travelling Potter-Bucky carriage. This consists of a lever mounted horizontally upon a vertical axis, which transmits the motion of the tube reciprocally to the carriage. Its length is equal to the focus-film distance. Its axis is variable along the length of the lever, in order to allow of the selection of any desired plane of the patient's body. Experiments to demonstrate its accuracy, and its applications to clinical radiography are described and discussed. AUTHOR.

***2830. Spectral Distribution of Radiation from the "Biosol." A. van Wijk.** *Philips Techn. Rev.* 2. *pp.* 18–23, *Jan.,* 1937.—A short description of the "Biosol" tubular, quartz-mercury lamp and supply arrangements, followed by a discussion of measurements of the spectral intensity distribution. The spectral sensitivity curves for various biological and therapeutic applications of u.v. radiation are also discussed, and conclusions are drawn regarding the efficacy of the lamp. AUTHOR.

**2831. X-Ray Therapy and St. Bartholomew's Hospital H.V. X-Ray Tube. T. E. Allibone.** *Engineer,* 163. *pp.* 452–454, *April* 16, 1937.—An e.h.v. X-ray tube has been erected at St. Bartholomew's Hospital [see Abstract 923 (1937)] to assist in the quantitative determination of the selective radiosensitivity of cancer cells compared with that of normal healthy cells and the dependence of this selectivity upon the wave-length of X-rays. In certain treatments of cancer it is an observed biological fact that $\gamma$-rays from Ra (B + C) are more beneficial than 200 kV X-rays. It is shown in a figure that the filtered rays from a $10^6$V X-ray tube will have an energy distribution comparable with that from Ra except for two $\gamma$-rays of energy 1·2 and 1·8 × $10^6$V, so that if there is a dependence of radio-sensitivity on wave-length, experiments with a $10^6$V X-ray tube should establish this dependence without doubt. To embrace the whole $\gamma$-ray spectrum 2 × $10^6$V would be necessary, but the difference between the latter and 200 kV is sufficient to make experiments at $10^6$V worth while, leaving higher voltages to be investigated at a later date. The intensity of output of radiation is measured by a parallel plate chamber placed on a cylinder in the treatment room on which the applicators are mounted. This chamber collects all the ions produced between its plates by the X-rays passing through the chamber (currents of several $\mu$A are produced) and is a direct measure of the intensity of radiation leaving the tube, which is expected to reach values of the order of 40 r./min. per mA at 1 m. from the focal spot of the tube when operating at 1000 kV. As the tube has already been operated at 6 mA at 800 kV the anticipated output of about 200 r./min. may be compared with the 0·05 r./min. available at 1 m. from a 5 gm. Ra unit. In order to reduce to reasonable time the treatment of cancer by Ra units very short Ra-skin distances are necessary [see Abstract 1381 (1937)], with the disadvantage that the depth dose at 10 cm. is limited by inverse square law to only about 10 % of the skin intensity. Since treatment is limited by the dose the skin will tolerate without suffering permanent harm, as high a depth dose as possible is to be preferred. At 75 cm. or 100 cm. focus/skin distance, the inverse square law is ceasing to influence the depth dose by more than 20 % and at 2 m. by more than 10 %. With the great intensities available from the h.v. X-ray tube, treatments will be only of nominal duration at distances of 1 m. to 2 m. from the tube. A further advantage is that the beam can be heavily filtered to eliminate all but the most penetrating rays, accentuating any dependence upon wave-length which may exist for cancer cells. A filter of 5 mm. Pb would only reduce the total intensity by about 70 %, while an increase to 1 cm. Pb would leave about 10 % of the original beam intensity and produce an even more homogenous beam of X-rays with a mean equivalent energy of 700 kV. T. A. C.

*2832. **Experimental Realisation of the Röntgen. C. E. Eddy.** *Brit. J. of Radiology,* 10. *pp.* 408–426, *May,* 1937.—The X-ray standardisation equipment of the Commonwealth X-ray and Radium Laboratory, University of Melbourne, for the realisation of the röntgen is described. The free-air ionisation chamber, which is of the Bureau of Standards guarded-field type, serves as the primary standard of X-ray dosage in Australia. The methods of measuring the various quantities involved in a determination of the röntgen are outlined. The accuracy with which the unit is realised is believed to be of the order of 0·5 %. Although further work will be carried out in an endeavour to improve the accuracy, that at present obtained is considered adequate for the calibration of clinical dosemeters. It has been found that, by a suitable arrangement of diaphragms, with the tube diaphragm within a few cm. of the focal spot, an X-ray beam of approximately uniform cross-sectional intensity can be obtained. With such a beam the inverse square law has been found to hold over a wide range of working distances. As a result of this, the calibration of clinical dosemeters is facilitated. The influence of the humidity of the ionised air is discussed, and the suggestion made by other workers that the röntgen might be better defined in terms of the ionisation produced in unit mass of air is supported. AUTHOR.

**2833. Radium Poisoning. Robley D. Evans.** *Am. J. of Roentgenology and Radium Therapy,* **37.** *pp.* **308–378,** *March,* **1937.**—Quantitative analytical study of radium poisoning has been made in respect to treatment of a living victim. In chronic cases the Ra stored in the skeleton and tissues gives rise to Rn in the expired breadth. The Rn and, indirectly, the amount of Ra producing it, is determined by tests on the expired air by an instrument which has been developed and which is described. The Ra in the remainder of the body is determined by the $\gamma$-rays from the decay product Ra C. Very sensitive quantum-counters allow detection of the $\gamma$-radiation from less than $10^{-6}$ grain of Ra, these instruments permitting more rapid and accurate detection than is possible with electroscopes in the case of living persons. A method of determining the $\gamma$-ray emission from any Ra victim, enclosed in a closed container, is described. These quantum-counters are calibrated for rapid measurement of the Ra C content in human victims in terms of observed $\gamma$-radiation for various parts of the body. Rate of loss of Ra by the patient is measured by Ra analyses of the fæces and urine. In chronic cases 0·005 % per day is eliminated in the proportion of 91 % in fæces and 9 % in the urine. Experiments have been made upon animals. Examinations of patients will detect chronic Ra poisoning 5 to 10 years before clinical symptoms appear. B. J. L.

*__2834. Routine Purification of Radon. T. H. Oddie.__ *Brit. J. of Radiology*, 10. *pp.* 348–359, *April*, 1937.—A radon extraction and purification apparatus for the speedy handling of large amounts of radon is described. The method of purification is physical rather than chemical in principle; water and other vapours are removed by freezing with solid $CO_2$; all the $H_2$ and $O_2$ and He are pumped off while the radon is condensed with liquid air, and $CO_2$ is removed with fused KOH. The method compares well with others as regards the time of operation and the degree of purity and percentage yield of radon. AUTHOR.

**2835. Attempt at Precision Measurement of $\gamma$-Rays. W. V. Mayneord and J. E. Roberts.** *Brit. J. of Radiology*, 10. *pp.* 365–386; *Disc.* 386–388, *May*, 1937.—The paper describes measurements of the ionisation produced in air by Ra sources. Various errors such as scattering from the wall of the ionisation chamber and room, finite size of chamber and source, atomic number of walls of chamber, etc., are discussed in detail. A carefully standardised measuring system is described, and the results of measurements with C, Mg, Pb, and paraffin wax chambers are given. A section of the paper is devoted to questions of accurate measurement of Ra sources, particularly in relation to the errors which may arise from the use of various types of ionisation chamber. It is concluded that the total charge set free per cc. of air at N.T.P., at 1 cm. distance from a point source of 1 mg. Ra element filtered with 0·5 mm. Pt, is 8·3 e.s.u./hr. AUTHORS.

## OSCILLATIONS AND WAVES.

**2836. Valve Amplification Methods in the Study of Single Elementary Particles. Part I. M. Mandò.** *N. Cimento*, 14. *pp.* 14–44, *Jan.*, 1937.—The relative merits of differents methods of valve amplification as applied to the study of single elementary particles are discussed with respect to: (*a*) resolving power, (*b*) stability, (*c*) constant and proportional amplification over a wide range of variation of initial potential, (*d*) low background, and (*e*) independence on the time of collection of the ions in the ionisation chamber. F. C. C.

*__2837. Differential Voltage-Amplifier. O. H. Schmitt.__ *Rev. Sci. Instruments*, 8. *pp.* 126–127, *April*, 1937.—An arrangement for amplifying an alternating p.d. between two electrodes, each having high impedance to ground. The two potentials whose difference is required are applied to the two control-grids of a matched pair of high-$\mu$ pentodes, one serving as a normal amplifier of high gain and providing the output to be measured. The output of the second pentode is applied to the screen-grid of the first, and the arrangement is balanced by means of two rheostats, so that there is zero resultant output when the potentials of the two control-grids are equal. The gain is about 160 and is independent of frequency up to about 20 kc./sec. L. H.

**2838. Abnormal Ionisation of the E-Region of the Ionosphere. L. V. Berkner and H. W. Wells.** *Terr. Mag.* 42. *pp.* 73–76, *March*, 1937.—Abnormal ionisation of the E-region of the ionosphere occurred very infrequently at Huancayo, Peru (12° south, 75° west), during nearly 8000 hrs. of observation. At Watheroo, Western Australia (30° south, 116° east), the effect was about 70 times as pronounced during the same period. Huancayo is on the geomagnetic equator, while Watheroo is in geomagnetic latitude about 42° south. This evidence suggests that sporadic ionisation of the E-region is a function of latitude, or more probably of magnetic latitude. It is observed that sporadic ionisations appear most frequently during local summer at stations in the temperate zones. Nevertheless, because of the much greater prevalence of thunderstorms near Huancayo as compared to Watheroo, the suggestion that the effect is related to thunderstorms does not seem to be supported. There is some evidence that the abnormal ionisation may be related to magnetic bays and auroræ which have a similar distribution with latitude and probably originate largely in the same atmospheric region. AUTHORS.

**2839. Ionisation of the Upper Part of the Ionosphere. Irène Mihul and C. Mihul.** *Comptes Rendus*, 204. *pp.* 1171–1173, *April* 19, 1937.—Observations show that the ionised layer known as the F-layer splits up into two maxima during the day, an inferior maximum corresponding to a layer $F_1$ and a second maximum of greater electron concentration corresponding to a higher layer $F_2$. After their separation in the morning the $F_2$-layer mounts to very great altitudes and then descends during the afternoon, until it is confused with the $F_1$-layer. The true explanation of the phenomena is to be found in the variation of the gradient of the electronic density of the ionosphere, with respect to altitude, with the position of the sun. Calculations are made of the apparent heights of the reflecting layers, the calculations being based on the theory of Ionescu and Mihul [see Abstract 4563 (1935)], and the results are found to be in good agreement with the experimental results of Berkner and Wells. The conclusions regarding the ionisation of the upper layers of the ionosphere are confirmed by the observations of echoes of long duration very frequently found in tropical regions, precisely when the conditions of ionisation are favourable to the functioning of ionospheric canals in the upper ionosphere. A. W.

**2840. Effect of Thunderstorms and Magnetic Storms on Ionisation of the Kennelly-Heaviside Layer. J. N. Bhar and P. Syam.** *Phil. Mag.* 23. *pp.* 513–528, *April*, 1937.—Records were made of the ion content of the Kennelly-Heaviside layer at Calcutta during the months of April to July (1935) when thunderstorms are of frequent occurrence, mostly in the afternoon. These records were then compared with thunderstorm and magnetic storm data obtained from the meteorological observatories at Alipore, Calcutta and at Colaba, Bombay, respectively. It is concluded that a marked association exists between the occurrence of a thunderstorm

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and an abnormal increase in E-region ionisation. There is little, if any, relation between magnetic disturbances and abnormal E-region ionisation. There is no relation between magnetic disturbances and thunderstorms. It is evident that one or both of the processes pictured by Wilson may be at work when a strongly electrified cloud is present. Although the association between magnetic disturbances and abnormal increases of E-region ionisation is not very marked, yet the values of the statistical coefficients obtained in the case of evening observations indicate that these are by no means independent of one another. A. W.

**2841. Ionospheric Conditions During the Solar Eclipse of June 19th, 1936. R. Naismith.** *Phys. Soc., Proc.* 49. *pp.* 214–224, *May* 1, 1937.—The radio observations made in south-eastern England during the five days centred on the eclipse of June 19th, 1936, are described. The eclipse was sufficient to increase the minimum equivalent height of the F-region from 300 to over 600 km. and to decrease the ionisation of the same region by about 50%, although only 56% of the sun's disc was obscured at the maximum phase. The effect on these two elements reached a maximum at the same time and occurred 30 min. after the eclipse reached its maximum. A large magnetic disturbance occurred during the period of observation. The radio observations are therefore discussed in relation also to the changes which occurred in the magnetic elements during the effect of the eclipse on the ionosphere. The results of a number of field-strength measurements made on signals traversing the path of the eclipse are given and interpreted in relation to the ionospheric measurements made at vertical incidence. The coincidence of the eclipse with sunrise over south-eastern England suggests that the minimum of ionisation thereby created made this the control region so far as the long-distance transmissions are concerned. This explains the close correlations which have been found to occur. It is shown that a reduction in field-strength was associated with the time during which the eclipse effect occurred in the path of the signals. AUTHOR.

**2842. Variation of Equivalent Heights of the Ionosphere. S. S. Banerjee and B. N. Singh.** *Zeits. f. Physik,* 105. 5–6. *pp.* 309–318, 1937.—Using waves of wave-length 78 m. measurements were made of the time required for echoes from the E-layer. It was found that the height of this layer increases during the morning hours, which may be accounted for by the formation of the lower D-layer. This D-layer must possess a fairly broad ionisation maximum, since only in that case can the apparent increase of the path and the increased absorption be explained which are observed as the critical frequency (140 m. wave-length) of this layer is approached. A. W.

**2843. Motions of Electrons in a Gas in Presence of Variable Electric Fields and Constant Magnetic Field. V. A. Bailey.** *Phil. Mag.* 23. *pp.* 774–791, *April,* 1937. *Supplement.*—A general theory is developed for the motions of electrons in a gas subjected to a variable electric field and a constant magnetic field. The formulæ obtained are tested by application to the particular cases of (*a*) a sinoidal electric field and (*b*) an electric field having two undamped components of different frequencies, which are parallel to each other and perpendicular to the magnetic field, each component having zero phase angle. [See also Abstract 4172 (1934).] A. W.

**2844. Effects Caused in the Ionosphere by Electric Waves. Part I. V. A. Bailey.** *Phil. Mag.* 23. *pp.* 929–960, *May,* 1937.—

A fresh investigation is made of the theory of the interaction of radio waves, and this leads to the following results (among others): (1) The theory of the interaction caused by powerful long-wave stations is in good agreement with the observations of van der Pol and van der Mark in all essential respects. (2) When a station radiates a wave whose frequency is made to pass through the local gyro-frequency there occurs notable resonance in the radio interaction which may be caused by this station. (3) With frequencies near the gyro-frequency a radiated power of amount as low as 1 kW may suffice to cause observable interaction. (4) By means of a gyro-station observations may be made which allow the values of the local terrestrial magnetic force and collision frequency $\nu$ to be estimated. [See preceding Abstract.] AUTHOR.

**2845. Division of Primary Electron Current Between Grid and Anode of a Triode. D. M. Myers.** *Phys. Soc., Proc.* 49. *pp.* 264–278, *May* 1, 1937.—The paper describes a method of determining the distribution, between the grid and anode, of the current emitted by the kathode of a cylindrical triode. Measurements of the temperature of the anode are used to verify that this distribution depends on the ratio of the voltages applied to the anode and grid, and not on their absolute values. A direct method is then described in which the grid and anode currents are measured in conditions such that there is no flow of secondary current; by this means, the distribution of primary current from the kathode and the value of any secondary current flowing between the anode and grid can be deduced in any conditions of operation. Curves are obtained by the former method, showing the variation with impact energy of the secondary-emission ratio for both Ni and Mo anodes. The effect of the anode-voltage : grid-voltage ratio on the distribution of primary current is determined for a particular triode, and an empirical relation is shown to hold for a considerable range of voltage-ratios. This relation is of the same form for any cylindrical triode, but no general relation, applicable to any cylindrical triode, has yet been found. AUTHOR.

***2846. Voltage Regulation by Gaseous Discharge Tubes. C. Morton.** *Journ. Sci. Instruments,* 14. *pp.* 161–164, *May,* 1937.—In the use of gaseous discharge tubes as voltage regulators, it has been customary hitherto to restrict the regulated power to that which the discharge gaps are capable of dissipating, and the high cost of tubes of adequate discharge capacity has limited thier application in general laboratory work. A method is described whereby inexpensive neon tubes may be used to stabilise relatively large power outputs, and data are given for the design of regulators which deliver direct currents of any desired magnitude and degree of constancy. As an example a description is given of a constant-current supply system which provides regulation within 0·0005% for supply variations of ± 20%. AUTHOR.

*See also* Abstracts 2443, 2747, 2779, 2786, 2802, 2840.

## PHOTOELECTRICITY.

**2847. Theory of Atomic Photoelectric Effect. F. Renner.** *Ann. d. Physik,* 29. 1. *pp.* 11–24, *May,* 1937.—The atomic photoelectric effect is investigated theoretically by wave-mechanical methods and the expression previously obtained by Fischer and Sauter for the directional distribution of the photoelectrons is derived in a simple manner. L. A. W.

**2848. Photoelectric Measurements on Sb. V. Middel.** *Zeits. f. Physik,* 105. 5–6. *pp.* 358–377, 1937.—A thin film of metallic Sb, deposited

V.4
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by kathode sputtering, was found to show the internal photoelectric effect with a maximum at 3700 Å. Measurements were made of the primary effect as distinct from the secondary effect, by the method of v. Schönwald. Measurements were made also on the external photoelectric effect; the threshold was found to lie between 3000 and 3100 Å, but no selective maximum at 2000 Å, as required by theory, was found. D. H. F.

**2849. Photoelectric Effect and its Application in Photoelectric Cells. M. C. Teves.** *Phillips Techn. Rev.* 2. *pp.* 13–17, *Jan.*, 1937.—This article discusses the principles of photoelectric phenomena. The external photoelectric effect is dealt with in greater detail, and is followed by a description of technical developments culminating in modern photoelectric kathodes. AUTHOR.

**2850. Energy Distribution of Photoelectrons Emitted by Calcium and Calcium Oxide. I. Liben.** *Phys. Rev.* 51. *pp.* 642–647, *April* 15, 1937.—Measurements of the energy distribution of the photoelectrons emitted from Ca with the aid of a magnetic velocity analyser using radiation of wave-length λ2536 have been made. Special care was taken to eliminate contact potentials and to ensure that the emission observed was that from pure Ca. Energy distribution curves were obtained for pure Ca, CaO, and for a number of stages intermediate between the oxide and the pure metal. The theories of Fowler, DuBridge, Mitchell, and Nottingham were found to compare favourably with the data for pure Ca on the high energy side, but to depart from the data at low energies. The photoelectric work function obtained for pure Ca was 3·21 eV. The failure of all attempts to fit the above theories to the data for the oxide indicates that the Sommerfeld theory of a metal is not applicable to CaO. AUTHOR.

***2851. Blocking-Layer Photo-Cells Irradiated with Soft X-Rays. H. Felsinger.** *Ann. d. Physik*, 29. 1. *pp.* 81–96, *May*, 1937.—A description is given of an apparatus for the investigation of the action of X-rays of wave-lengths from 0·5 to 2·5 Å upon $Cu_2O$ and Se blocking-layer photo-cells, the cells being mounted in the vacuum of the X-ray tube. Photoelectric currents and e.m.f.s of cells of the types mentioned are measured as functions of the anti-kathodic current and tube voltage and the experimental results are expressed in graphical form and discussed. L. A. W.

**2852. Photosensitive Capacity of Anthracene Dyes. (Miss) Hoang thi Nga.** *Comptes Rendus*, 204. *pp.* 429–430, *Feb.* 8, 1937.—Previous work suggested that photosensitivity was related to the presence of the $NH_2$ group. A number of dyes have now been examined and it is concluded that the electrolyte is without effect, but that N atoms must be present in the molecule to give photosensitivity. [See following Abstract.] F. S.

**2853. Photovoltaic Effects of the Diamines of Naphthalene. (Miss) Hoang thi Nga.** *Comptes Rendus*, 204. *pp.* 763–764, *March* 8, 1937.—Photovoltaic measurements were made, under illumination by the Hg-vapour lamp, of the diamines of naphthalene in which the $NH_2$ groups occupy the 1–2, 1–8, 2–7 positions, using several different electrolytes. The results show that the 1–2 amine is the least sensitive. This is in accordance with the hypothesis that when the $NH_2$ groups are in neighbouring positions their mutual influence has an effect on the photo-sensitivity of the molecule. [See preceding Abstract]. D. H. F.

**2854. Properties of the Rectifying Layer in Photovoltaic Cells. W. P. Jouse.** *Phys. Zeits. d. Sowjetunion*, 11. 1. *pp.* 122–127, 1937. *In German.*—In a former paper it has been shown that the action of photovoltaic cells depends on the presence of a surface layer of high resistivity between the metal and the semiconductor [see Abstract **2224** (1935)]. Now layers of different kind are artificially produced and tested for photoelectric action. It is found that only those materials are effective which show an internal photoelectric effect of their own (*e.g.* $Tl_2S$) while layers of bad conductors with no internal photoelectric effect ($SiO_2$, $B_2O_3$) are ineffective. The spectral sensitivity curve is measured for different cells. It usually contains two maxima, one due to the layer ($Tl_2S$) and the other characteristic of the metal-semiconductor combination ($Cu$-$Cu_2O$). The result is discussed. R. P.

**2855. Fatigue in Secondary Emission from Photosensitive O–Cs Kathodes. I. F. Kwarzchawa.** *Phys. Zeits. d. Sowjetunion,* **10.** 6. *pp.* 809–819, 1936. *In German.*—Measurements were made on the falling-off of the secondary emission from O–Cs kathodes under prolonged bombardment. The results are shown to be consistent with the hypothesis that the secondary electrons are emitted from a layer of Cs atoms adsorbed on a $Cs_2O$ film. The fatigue is a result of the poor conductivity of the $Cs_2O$ layer; this allows the surface to become charged, and a field is set up driving Cs ions away from the surface, thus reducing the amount of Cs available. The fact that fatigue may not occur under intense bombardment is explained as resulting from an increase of the conductivity of the $Cs_2O$ layer on account of the penetration of a sufficient number of the bombarding electrons. It was found that the secondary emission of this kind of kathode increased progressively with increase of the amount of O embodied, and it is shown how this is consistent with the above hypothesis. D. H. F.

*See also* Abstracts **2494, 2536, 2563, 2568, 2761, 2765, 2801, 2861.**

## PIEZOELECTRICITY.

**2856. Excitation of Piezoelectric Vibration in Rochelle Salt. R. Hiltscher.** *Zeits. f. Physik,* **104.** 9–10. *pp.* 672–680, 1937.—It is shown that the luminous effects which can be observed near an oscillating quartz crystal can also be observed near a Rochelle salt crystal. Calculations show that in Rochelle salt the piezoelectric effect is in a plane perpendicular to the direction of the applied electric field. Calculation is made of the efficiency of a Rochelle salt crystal as a radiator of ultrasonic radiation and it appears that the radiation per unit volume is only about 1 % of that obtainable from quartz. J. E. R. C.

**2857. Piezoelectric Constant of Quartz. J. Clay and J. G. Karper.** *Physica,* **4.** *pp.* 311–315, *April,* 1937. *In English.*—The piezoelectric charge of quartz for pressures up to 10 kg./cm$^2$. is measured in absolute value with an accuracy of 0·1 % at 17°, 60° and 90° C. A small coefficient of temperature is found. AUTHORS.

**2858. Flexural Vibrations of Piezoelectric Quartz Bars and Plates. J. T. Tykociner and Marion W. Woodruff.** *Univ. of Illinois. Eng. Exp. Sta., Bull. No.* 291. [28 *pp.*], *Jan.* 8, 1937.—Flexural vibrations are excited piezoelectrically in quartz bars of selected dimensions and the resonant frequencies, which ranged from 3·5 to 306 kc./sec., were measured. From the results, taken in conjunction with theoretical considerations, a formula is developed for the natural frequency. It is accurate to about 1 %, and holds for X-cut and Y-cut bars. A bridge method is developed for detection of the response at frequencies below 15 kc./sec. P. V.

***2859. Rochelle-Salt Piezoelectric Resonators Having a Pure Longitudinal Mode of Vibration. N. C. Stamford.** *I.R.E., Proc.* 25. *pp.* 465–471, *April,* 1937.—The correct orientation of specimens cut from Rochelle salt crystals for use as piezoelectric resonators having a pure longitudinal mode of vibration is developed from Voigt's theory of piezoelectricity, and the frequency of resonance of these specimens is derived from the constants of the material. Some practical details are given regarding the growing of the crystals and grinding of the specimens.
AUTHOR.

## THERMIONICS.

**2860. Evaporation Velocity of Barium Oxide. G. Herrmann.** *Zeits. f. phys. Chem.* 35. *Abt.B.* 4. *pp.* 298–308, 1937.—The influence of the metallic base on the rate of evaporation of BaO is investigated. The apparatus is described together with details of the temperature measurement of the oxide surface, and the loss of oxide. The heated surface is inside a glass cylinder (in a further evacuated glass vessel) and the solid precipitated on this cylinder is estimated by normal chemical methods. The temperature of the oxide surface is estimated by having on it some specks of $Cr_2O_3$, the black-body temperature of which is measured by means of a pyrometer. A measurement of the radiation coefficient of the BaO is also made, for $\lambda = 0{\cdot}65\mu$ and is found to be 0·18–0·30. The molar heat of evaporation is found to be 119,000 cal. Bases of Pt, Ni, Au, and Cu appear to have no effect on the rate of evaporation. A relation is deduced between the vapour pressure of BaO and the absolute temperature. It is found further that with a Ni base there is some reduction of the oxide to Ba.
E. H. D.

**2861. Thermionic Emission in Heated Tube-Counter. H. Haberland and W. Walcher.** *Zeits. f. Physik,* 105. 5–6. *pp.* 348–357, 1937.—The kathode of a cylindrical Geiger-Müller counter was provided with a heating coil, and the counting rate was measured at different temperatures. A reproducible thermionic emission appeared at 400–500° C. with Fe and Ni kathodes. The emission conformed to the Richardson equation.
D. H. F.

**2862. Secondary Electron Emission from Oxidised Silver and Molybdenum Surfaces. A. W. Afanasjewa and P. W. Timofejew.** *Phys. Zeits. d. Sowjetunion,* 10. 6. *pp.* 831–839, 1936. *In German.*—The secondary electron emission from oxidised Ag and Mo surfaces is for all velocities of the primary electrons less than that from surfaces of the pure metals. The decrease of the secondary emission for a thickness of oxide coating of 50 molecular layers is brought about by the increased work of emission of the electrons. The further reduction of the secondary emission with increased thickness of the oxide coating is explained by the smaller emissivity of the oxides of Ag and Mo as compared with the pure metals. The location and the height of the maximum secondary electron emission depends on the quantity of the gases adsorbed by the metal or metal oxide surfaces.
A. W.

***2863. Secondary Electron Emission from Thin Metal Films on Glass. A. Afanasjewa, P. Timofejew and A. Ignatow.** *Techn. Phys., U.S.S.R.* 3. 12. *pp.* 1011–1019, 1936. *In German.*—Apparatus for evaporating films of Ag, Ni, Mo and W on glass and measuring the secondary electron emission for primary electron velocities up to 1500 V. is described. It was found that with glass surfaces and primary velocities of

200–250 V, the ratio of the number of secondary electrons to the number of primary electrons is unity, but with increasing primary velocity this ratio increases to a maximum never exceeding 1·5 and then decreases. It is shown that the potential of glass fluorescent under the impact of electrons is very close to that of the positive electrode accelerating the electrons. The secondary electron emission from thin metal films on glass was found to decrease with decreasing thickness, and was less than that of the corresponding massive metal. Similarly, the primary electron-velocity corresponding to the maximum in secondary emission decreases with diminishing film thickness. A. G. Q.

**2864. Secondary Electron Emission of Soot in Valves with Oxide-Kathodes. H. Bruining, J. H. de Boer and W. G. Burgers.** *Physica,* 4. *pp.* 267–275, *April,* 1937. *In English.*—When a carbon surface is covered with Ba atoms, the capability for secondary emission rises in the first instance. However, soot directly precipitated from the atmosphere round a burning flame is composed of very small particles and was found to behave exceptionally. It is apparent from the change of the secondary emission with time that the Ba atoms, precipitated on this carbon modification, fade away by a moderately strong electron bombardment. Owing to local heatings the Ba migrates then to soot particles at greater depth. Soot, sprayed on a metal surface, shows this migration in less degree. In this modification the small particles are conglomerated to larger ones. This is confirmed by electron diffraction experiments. AUTHORS.

*See also* Abstracts 2727, 2801, 2802, 2845.

## THERMOELECTRICITY.

**2865. Thermo-E.M.F. of a Supraconductor against the Same Metal in the Non-Supraconductive State. J. A. Kok.** *K. Onnes Lab. Leiden, Comm., Suppt. No.* 84*a. Physica,* 4. *pp.* 276–278, *April,* 1937. *In English.*—The similarity is pointed out of Gorter's cycle and a thermoelectric cycle, consisting of one metal, partially in the supraconductive and partially in the non-supraconductive state. From a plausible assumption relations are derived for the thermoelectric properties. AUTHOR.

**2866. Change of the Thermo-E.M.F. in Bismuth Crystals on Transition from Transversal to Longitudinal Magnetic Field. E. Grüneisen and J. Gielessen.** *Ann. d. Physik,* 29. 1. *pp.* 25–32, *May,* 1937.—A continuation of previous papers [see Abstract 1788 (1937)]. The change of the thermo-e.m.f. of Bi crystals was measured in the magnetic field when this turned from the transversal to the longitudinal position relative to the flow of heat. The earlier results were confirmed both for Bi $\parallel$ and for Bi $\perp$. In the longitudinal position the magnetic field has a relatively small "positive" influence on the thermo-e.m.f. of Bi $\parallel$. A maximum of $\sim +6\ \mu\mathrm{V}$ was observed. On the thermo-e.m.f. of Bi $\perp$ the influence is great and of "negative" sign. A value of $-100$ to $-120\ \mu\mathrm{V}$ was observed. The field reversal effect, only feeble with Bi $\parallel$, but at times strong with Bi $\perp$ always disappears with the longitudinal position of the field. The connection between the change of the thermo-e.m.f. and the change of heat conduction in magnetic fields is shown graphically. J. J. S.